TWELFTH ANNUAL REPORT OF THE BUREAU OF SCIENCE

PHILIPPINE ISLANDS

TO THE HONORABLE
THE SECRETARY OF THE INTERIOR

BY

ALVIN J. COX
ACTING DIRECTOR OF THE BUREAU OF SCIENCE

FOR THE YEAR ENDING
JUNE 30, 1913

MANILA
BUREAU OF PRINTING
1913

122638

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[1] Corrected to December 1, 1913.

[2] Appointed Director January 22, 1914.

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ILLUSTRATIONS

TWELFTH ANNUAL REPORT OF THE BUREAU OF SCIENCE

THE GOVERNMENT OF THE PHILIPPINE ISLANDS,
DEPARTMENT OF THE INTERIOR,
BUREAU OF SCIENCE,
Manila, July 15, 1913.

SIR: I have the honor to present a résumé of the researches of the Bureau of Science and of the work performed during the fiscal year ending June 30, 1913, together with a few recommendations regarding improvements which seem to me to be necessary.

The Bureau of Science was established as the Bureau of Government Laboratories on July 1, 1901, by Act No. 156 of the Philippine Commission, although actual chemical and biological work was first begun on September 25 of the same year when it was started with 6 employees in a rented house on Calle Iris, Manila. The photographic collection, which has developed rapidly and now includes some 15,000 negatives, and other photographic work were begun with the employment of an official photographer on November 16, 1901. Entomological investigations began on December 9, 1902, and with them the foundation of the present entomological collection of specimens. On January 1, 1903, the serum laboratory and the grounds at San Lazaro were transferred to the Bureau from the Board of Health. The section of botany which had been organized in the Bureau of Agriculture and the nucleus of the herbarium were added on July 1, 1903. On November 1, 1905, the Bureau of Mines ceased to exist and became an integral part of the Bureau of Science, and on November 1, 1906, the Ethnological Survey, formerly the Bureau of Non-Christian Tribes, which before that time had been incorporated with the Bureau of Education, was transferred to the Bureau of Science, and, as the division of ethnology, has undertaken the preliminary organization of the Philippine museum and has secured sufficient material to fill three-quarters of the space in the building assigned to it on Calle Juan Luna, one-quarter being reserved for the exhibit of the Bureau of Forestry. The collector of natural history specimens

of the Ethnological Survey was transferred directly to the Bureau of Science (then Bureau of Government Laboratories) on November 16, 1904.

The present laboratory building of the Bureau of Science, which was added to in 1911, was first occupied early in the year 1905, and at that time the work was enlarged by the appointment of an engineering force and by the operation of steam and electric machinery. From this small beginning has grown the present power plant which supplies electric current, steam, gas, etc. to the Bureau of Science, the Philippine General Hospital, and the College of Medicine and Surgery.

The purchase of books for the library began soon after the organization of the Bureau, and this adjunct of the scientific work grew rapidly, necessitating the gradual enlargement of the force and the organization of the library staff. The original plan contemplated an expenditure of ₱90,000 spread over a period of six years for sets of general periodicals and other books on chemistry, geology, zoölogy, bacteriology, pathology, physiology, and general sciences. Books purchased with this fund together with the thousands of pesos' worth of publications which were received gratis formed the nucleus of the scientific library of the entire Government. The valuable material received by gift and the continuations of sets purchased from current appropriations have been bound. These, together with the books and serial literature of the clinical principles such as surgery, skin diseases, and ophthalmology, which have been provided by the University of the Philippines, have been placed in the library.

Work made important by the needs of the Islands was from time to time added to the existing divisions. A cement-testing laboratory—including the testing of road materials and of concrete, sand, and gravel used in structural operations—and a laboratory for the examination of foods and drugs were developed within the division of chemistry. The serum laboratory, which at first had undertaken only the preparation of vaccine virus and a small quantity of antirinderpest serum, increased its scope so as to cover all sera prophylactics used by the Civil Government. The biological laboratory, which had always been connected closely with the Civil Hospital and had done the general scientific work for the Board of Health, undertook the diagnostic determinations for Bilibid Prison, for San Lazaro Hospital for contagious diseases, and, at a later date, a fair share of the teaching and hospital work belonging to the Medical

School. Investigations in the provinces, bringing with them a more extended study of helminthologic infections, also eventually became necessary in order to give a clear understanding of the general condition of the people. Members of the staff are also in periodic demand by the Bureau of Health in conjunction with the collecting of lepers for the Culion Colony. In 1910 the Philippine Assembly established a Bureau of Science sugar-testing laboratory at Iloilo. On November 9, 1910, funds were transferred to the Bureau of Science by the Governor-General for the building of an aquarium in the bastion immediately in front of Real Gate of the city wall. On June 10, 1913, the aquaria and circulating system had been placed in operating condition by the Bureau of Public Works and were turned over to this Bureau.

There was one transfer from the Bureau of Science, namely, that of the serum herd to the Bureau of Agriculture on January 1, 1907.

The Bureau of Science now has not only a local but an international reputation built up on the basis of the quality and volume of the scientific work which we have produced. In the course of the addresses given by those called upon to express His Imperial Majesty's, the German Emperor's, views, at the foundation of the Kaiser Wilhelm Institut for the prosecution of original research, attention was especially directed to the existence of a number of such institutions in America, and it was very gratifying to us to learn that the Philippine Bureau of Science was referred to as a great institution for investigation established by the Government.

The Bureau of Science performs a large amount of routine scientific work for many branches of the Government and for private parties. They are all benefited thereby, and the greater proportion of the results obtained have a permanent commercial value. In the tenth annual report of this Bureau, page 29, attention was called to the fact that in a single day the division of general, inorganic, and physical chemistry had carried on illumination tests of oil; heat insulation experiments; analyses of rocks, limestones and cements, water, soils, fertilizers, coals, and alloys; calorimetric determinations of fuels; standardizations of instruments of precision, of measures, and of solutions; as well as physical tests of clays, cements, aggregates, road materials, textiles—such as puttees, khaki cloth, raincoats, and blankets—and of reënforcing iron and of rope. From this, which was done in one division, one can gain an idea

of the variety of work carried on in a single day in the entire Bureau with its dozen divisions and sections. The analyses or examinations of samples of a given kind which are performed by the laboratory cannot often be segregated because with few exceptions they must be done promptly without waiting for others to accumulate.

Routine work does not prevent the Bureau from fulfilling its lawful function of conducting independent scientific research and working out the problems of economic importance, provided it be of a legitimate character. By a small nominal charge such as we make in most cases, we are able to exclude unimportant samples submitted out of curiosity and only of momentary interest; without such a charge we would be obliged to devote our entire time to routine work at the sacrifice of all our research work. The schedule of prices on the average does not cover more than the actual cost of routine analyses or examinations, on account of the extreme variety of the work. Certain types of analyses are made gratis exclusively for other branches of the Government, and in these cases it has been necessary only to approximate the cost for statistical purposes so the charges in the schedule may be more or less than the actual cost of the routine analyses or examinations. The charges for unusual and miscellaneous work are too low. The large variety of work makes economy of time difficult; the lack of room makes it imperative to disassemble apparatus as soon as work is completed instead of keeping it set up for similar work, as the space is needed for new work, and the irregularity with which requests are received interferes with the intertwining of suitable problems for research and investigations. The irregularity is partially overcome by enlisting the routine employees as secondary workers on investigations. The cost of performing routine work of a given class varies from time to time, depending upon conditions. In the United States a laboratory often secures a large amount of one class of work and can invariably employ cheap assistance and carry it on empirically. For instance, there are laboratories in the States where they do nothing but analyses of boiler water. In spite of their cheap labor, in almost every case their charges are higher than ours. Where the volume of any given class of work performed by the chemists, bacteriologists, assayers, or other employees is large, we are able greatly to reduce the unit cost and especially are we able to do so when we train and use the services of intelligent apprentices. At the present time we have an apprentice mechanical soil analyst, an apprentice milk analyst, and apprentice cement testers. Each of these is able

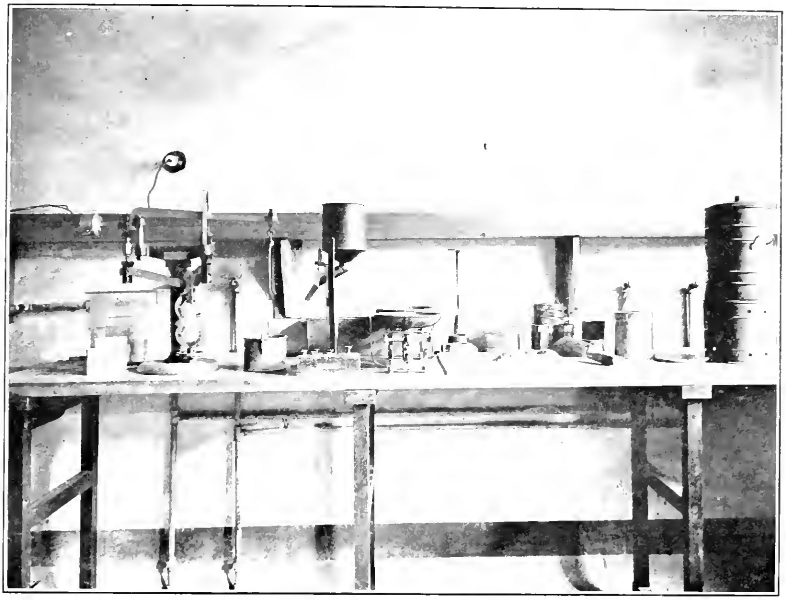


Fig. 1. Bureau of Science cement laboratory in 1906.

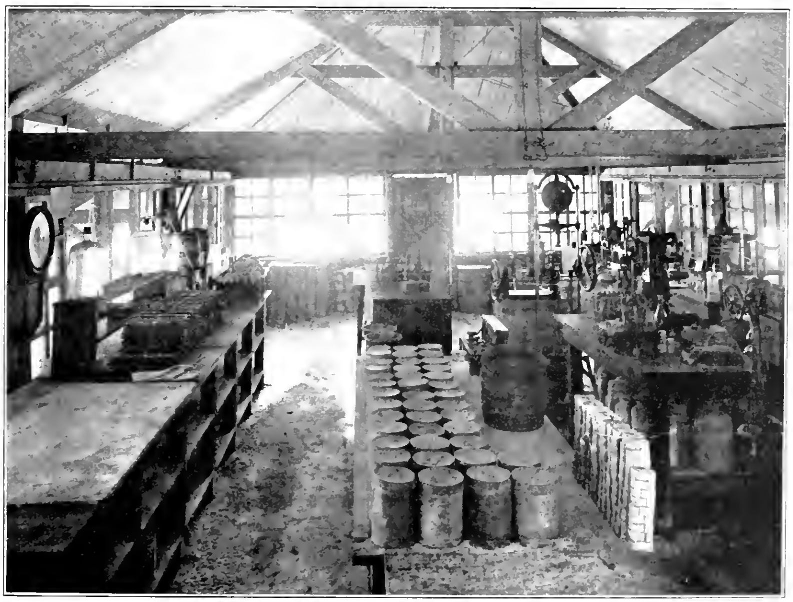


Fig. 2. Bureau of Science cement laboratory in 1913.

PLATE I.

to carry on a large part of the particular class of work independently and thus save the time of an expensive man. The cost of mechanical analyses of soils has been reduced between 50 and 75 per cent. As an illustration of how the price decreases with quantity, I have the honor to refer you to the history of our cement testing. In the fiscal year 1906 we tested fourteen cements; in 1907, one hundred eighty-five; in 1908, one thousand seven hundred nineteen; in 1909, three thousand five hundred ninety-six; in 1910, three thousand two hundred sixty-two; in 1911, three thousand seven hundred twenty-eight; in 1912, seven thousand nine hundred sixty-six; and during 1913 we tested more than nine thousand five hundred samples. In 1906 our authorized charge for cements was ₱30 per sample; in 1907, ₱15 per sample; and at the present time it is ₱0.60 for the same class of test. In the same manner, the cost of analyzing samples of water decreases rapidly when many samples are analyzed at one time. In the decreased cost of work with the increase in volume is to be found the strongest argument for the segregation of the scientific work of the entire Government in one institution like our own. Even when it is all brought together in one class, certain tests are so few in number that the unit cost of performing them becomes very high.

In general, people expect to pay more when work is done by a government laboratory because they have the prestige of the Government back of the results. We have avoided taking advantage of this as shown by the fact that our scheduled charges are consistently very much lower than the charges made by equally reputable commercial and other institutions or laboratories of the United States. Our continued effort is to be of as much assistance as possible, and often we carry work farther than is requested when it is evident that the public can be benefited. For example, sometimes individuals draw conclusions from analyses on the basis of findings in other countries. Often this is erroneous, and we endeavor to settle the problem by careful research.

The results of many of the investigations of the Bureau of Science, although available at present, do not become of most value until they are utilized from an industrial, commercial, or educational standpoint. Research work indicates the latent wealth of the nation, and bears the same relation to the commercial world that blocked-out ore does to a developed mine. The intrinsic value and the potential importance of this work are becoming more and more evident as its practical application is demonstrated and appreciated. It is not always easy to antici-

pate the needs of the country in order to determine which investigations should be carried on first, and certain problems require years for completion, so that much of the work becomes most useful at a later date. It is in the nature of the case that our work must precede the establishment of large industries and consultations with, and advice to, the public and other branches of the Government requiring scientific knowledge of a specialized character. A large amount of the research of this Bureau has been made available in our publications which to date comprise 20,000 printed pages, 2,000 illustrative plates, and nearly 1,000 text figures.

RÉSUMÉ OF THE RESEARCHES OF THE BUREAU OF SCIENCE

To give in a few pages a complete account of the investigations carried on by this Bureau would be impossible. The space which I propose to devote to this would not adequately record the accomplishments of a single division or section. For instance, to describe the work of the biological laboratory of this Bureau would be to write no small part of the history of the development of tropical medicine during the past twelve years. I desire to emphasize, however, that there is extensive information in the Bureau of Science which would effect a large annual saving to the inhabitants of these Islands if it were utilized, as shown in the following abstract of the work of the Bureau.

1. *General.*—Specimens of plants have been imported at considerable expense that might just as well have been secured in the Philippine Islands and in many cases in the city of Manila itself. Some living plants infested with various fungus diseases have been imported, and the introduction of such diseases might have been avoided if the plants had been submitted to this Bureau for examination. Some of the dam sites could have been more advantageously chosen had the geologist been consulted when the work was projected. At least one gold mill which cost several hundred thousand pesos now stands idle in the Philippines because there were no previous tests to show the kind of mill adapted to the ore. Investigation of one operating mill in the Philippines showed that a saving could be made of nearly ₱5 per ton of ore treated or about ₱94,000 per annum. Geologic investigations of artesian water show infeasible projects and prevent unwise expenditures. The specifications for a large Government building required a 1:2:4 concrete mixture. The mixture was found to give poor results. The cement and aggregate were carefully studied by this Bureau, and it was found that a 1:2:5 mixture gave better results and was more satisfactory than the 1:2:4

Fig. 1. Lung of guinea pig which died of advanced plague infection, after being exposed to air in which plague bacilli were suspended by means of spraying.

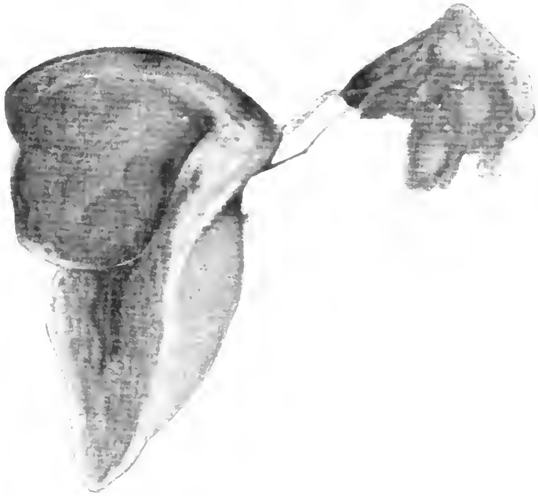


Fig. 2. Lung of monkey which died of pneumonic-plague infection from inhalation, showing progression of lesions; lobular and lobar pneumonia.

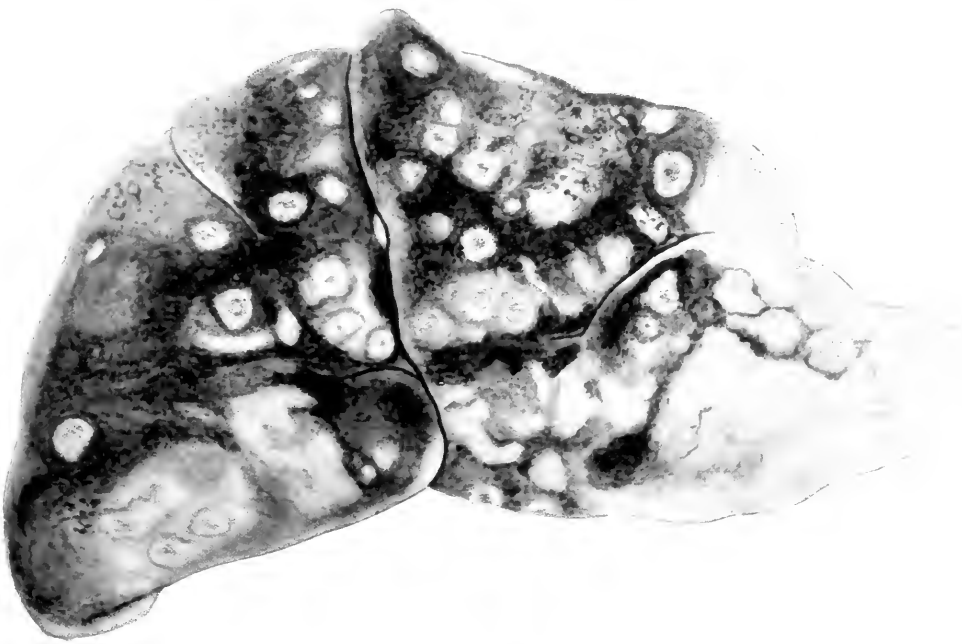


Fig. 3. Lung of dog with pneumonic plague.

PLATE II.

mixture. The contractor was allowed to use the 1: 2: 5 mixture in the construction work. If it had been known by the engineers in charge before bids were submitted that this mixture was as good as the 1: 2: 4, there could have been a large saving. Several thousands of pesos were paid to private laboratories in Europe and America for the purpose of ascertaining the suitability of submitted samples of local raw cement materials for commercial use. In most instances this Bureau in the beginning could have done the work cheaper and more efficiently. The results gave no definite information until the material was submitted to our experts for examination. Our equipment for conducting investigations is much better than that of most commercial laboratories, and our scientists are familar with local conditions which must be considered. Scientific information will assist the manufacturer of coconut products, soaps, beverages, alcohol, sugar, etc. Sugar planters' profits have been greatly augmented in many cases by scientific information regarding the proper time at which to crush their cane; that is, when the cane contains the maximum quantity of juice of maximum purity.

2. *Diseases of man.*—Medical surveys have been conducted in various parts of the Archipelago to determine the kinds of diseases and their prevalence. These diseases have been studied with reference to their etiology, pathology, treatment, immunity, and prevention. Knowledge has been obtained for the treatment and prevention of many of these that is of inestimable value not only to the inhabitants of the Philippines but to mankind in general.

The diseases of man which have been investigated in the biological laboratory include plague, cholera, bacillary dysentery, tuberculosis, leprosy, entamœbic dysentery, balantidiasis, malaria, helminthiasis, yaws, beriberi, meningitis, tropical ulcers, gangosa, varicella, mycetoma, splenomegaly, rabies, hand infection, and pinto. The first eleven of these are reviewed more fully as follows:

3. *Plague.*—Manila has suffered from two outbreaks of bubonic plague during the past nine years, and a representative of this Bureau went as the American delegate to the International Plague Conference in China during the epidemic of pneumonic plague in Manchuria in 1911. Therefore, abundant opportunity and material have been available for the study of both types of this disease. The investigation of pneumonic plague was based on the material brought from Manchuria. The method of the spread of this most contagious form of plague and the probable reason why epidemics of this form occur only in cold countries

have been indicated. The clinical symptoms, bacteriology, pathology, and the susceptibility of animals to pneumonic plague have been studied. Protective inoculations have been found to be less effective against pneumonic than bubonic plague. The first outbreak of bubonic plague in Manila after the American occupation was eradicated by the combined action of the Bureau of Science and the Bureau of Health, and the last case appeared in 1906. The first case of the present desultory outbreak occurred on June 19, 1912. The control of the present outbreak has been based upon the bacteriological diagnosis of the suspected cases of human plague and the examination of many thousands of rats. Investigations have been made as described on page 46.

4. *Cholera.*—Since July, 1911, not a single case of cholera has been reported in this Archipelago. This Bureau has taken an important part in its elimination by the pathological and bacteriological diagnosis of the disease, by the preparation of immune serum for diagnosis, and by prophylactic inoculations against it; the Bureau has also made many investigations on the cholera organism and immunization against, and treatment of, the disease. A new prophylactic, consisting of the immunizing substances extracted from the cholera vibrios, was devised and employed in immunizing in the last epidemic of cholera. Physiological and biochemical studies in this laboratory have determined the efficiency of different concentrations of saline solutions employed as extravenous injections in treatment of collapse in cholera, have found evidence of an acid intoxication in this disease, and on the basis of this evidence have proved that early administration of alkalies will practically eliminate death from uræmia. A new and quicker method of identifying the vibrio of Asiatic cholera has been devised (see page 47).

5. *Bacillary dysentery.*—Dysentery of bacterial origin, while not strictly a tropical disease, is one of increasing importance in warm countries. One type of the organism causing this disease was discovered in the Philippines, and sporadic cases, outbreaks, and epidemics are more frequently recognized. Several varieties of the dysentery bacillus are known. Investigations have shown that all of the different types occur in the Philippine Islands, and on page 47 recent isolation experiments by the single-cell method are described. Bacillary dysentery has been found to occur in monkeys of the Philippine Islands, a fact which might, under certain conditions, play a part in its spread. Infantile diarrhœas and dysentery are an important

Fig. 1. Vibrio of Asiatic cholera.

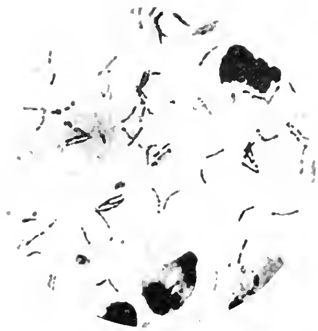


Fig. 2. Bacillus tuberculosis.

Fig. 3. An atypical strain of Bacillus dysenteriæ.

PLATE III.

Fig. 1. Pure culture of leprosy F from glycerine agar.

Fig. 2. Amœba with cholera vibrio and leprosy bacillus G. Second transplant from primary culture.

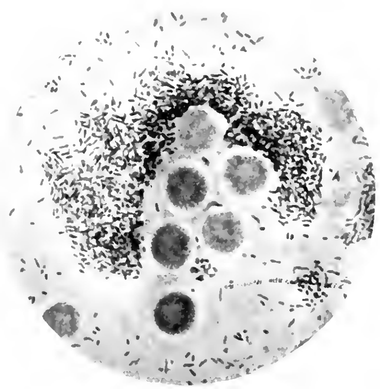


Fig. 4. Culture G. Leprosy bacilli with amœbæ and cholera vibrios. Stained with carbol-fuchsin and decolorized with Gabbet's stain.

Fig. 3. Smear from early lesion in guinea pig following a subcutaneous injection of a pure culture of leprosy bacillus F.

PLATE IV.

factor in the infant mortality of all tropical countries. In a study of an epidemic of infantile dysentery in 1908, an undescribed bacillus of the *coli* group, not *Bacillus dysenteriæ*, was found to be the causative organism.

6. *Tuberculosis.*—This disease constitutes one of the most important medical problems among the Filipinos. The incidence of infection has been more accurately determined by several medical surveys conducted by this Bureau than could be done by the statistics of hospital clinics. The pathology of various kinds of tuberculosis, notably of rare types such as adrenal tuberculosis, has been studied. Certain specific treatments of tuberculosis have been tested, and experiments in the attempt to immunize against tuberculosis with a virulent strains of *Bacillus tuberculosis* have resulted negatively. Recent studies of tubercular infections are described on page 47.

7. *Leprosy.*—The first cultivation of an organism from leprous tissue by this Bureau, even if it should prove not to be the specific organism of leprosy, has been the starting point of the extensive cultivation and experimental studies of leprosy now in progress all over the world. An investigation is now in progress with special reference to classifying those organisms cultivated from leprous tissue by different authors and to the determination of their etiologic relationship to leprosy. Studies on the cutaneous reaction in leprosy, as a method of diagnosis of the disease, as practiced in tuberculosis, and of the treatment of leprosy with a vaccine prepared from an organism cultivated from leprosy, and with certain chemicals, have been made.

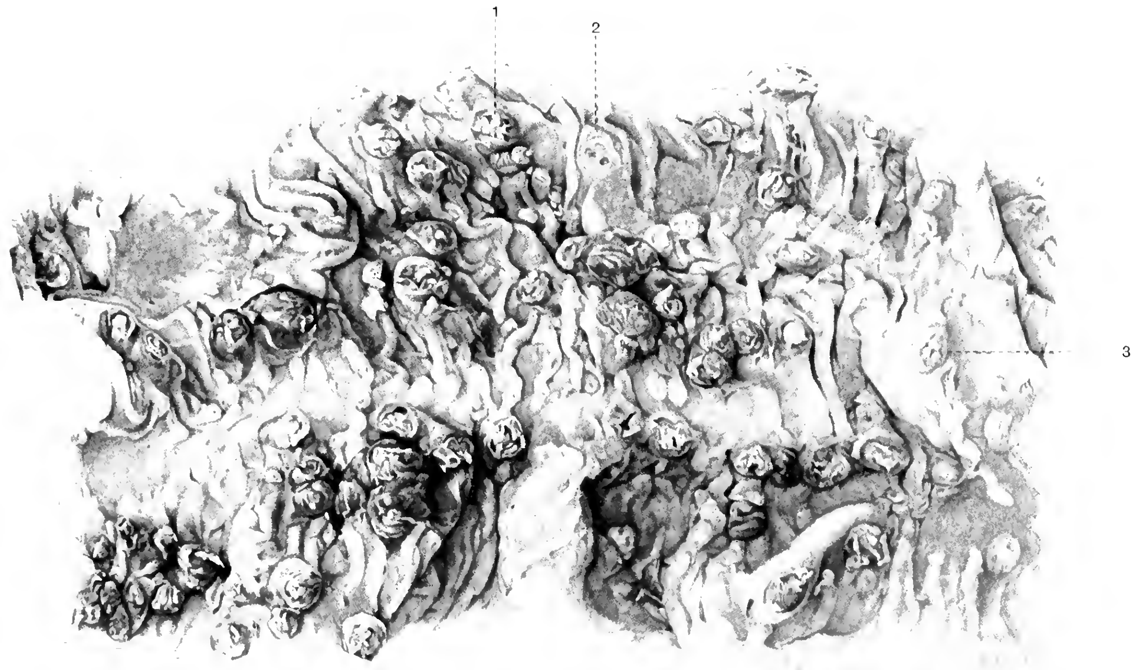
8. *Entamœbic dysentery* is a disease of universal distribution in the tropics and subtropics, and one which causes much sickness and death of white men. It was very prevalent in the Philippines in the early years of the American occupation, and, although sanitation has decreased its prevalence, it is still by no means uncommon. Its importance in the Philippines has led to much investigation of its etiology, diagnosis, pathology, and treatment. Recent morphological and experimental investigations carried on in this Bureau have determined once for all the specific entamœba concerned in the production of this disease, and have supplied information for the accurate laboratory diagnosis and for the scientific control of entamœbic dysentery. It has been determined that the entamœba causing dysentery lives only in the intestine of man, that every case of entamœbic dysentery is contracted from some other case of dysentery, and that it cannot be contracted from water or uncooked vegetables

unless they be contaminated with the fæces of a case of entamœbic dysentery. The results which have been obtained will appear in The Philippine Journal of Science (see page 48).

9. *Balantidiasis.*—The first case reported in the Philippine Islands of infection with the ciliated protozoan, *Balantidium coli,* was in 1900. The early reports of this Bureau indicated that balantidiasis, while sometimes giving rise to a fatal dysentery, was a disease of rare occurrence. However, recent investigations have shown that infections of man with this parasite are relatively frequent and of wide distribution in these Islands and consequently deserving of further study (see page 48).

10. *Malaria.*—This is probably the most widespread of all tropical diseases. Investigations conducted in this Bureau in 1910 showed that about 12,000 deaths due to it are reported each year in the Philippine Islands. Incidence of infection in certain parts of the Philippine Islands has been determined by medical surveys conducted by the Bureau of Science. At Taytay, Luzon, the incidence as determined by the examination of 1,131 persons was only 1.5 per cent. It was found to be prevalent in the pernicious type in Itbayat Island of the Batanes group, but no statistics were secured. At the San José estate on Mindoro the incidence as determined by the examination of over a thousand blood smears from different persons for malarial parasites was about 30 per cent (see page 48). Experiments have been conducted on the treatment of malaria with arsenophenylglycin and on the transmission of malaria by the anopheline mosquito, *Myzomyia ludlowii.*

11. *Helminthiasis.*—Infections with worm parasites are very prevalent in the Philippines as they are in all tropical countries. Numerous extended statistical studies have been made of the prevalence and distribution of the intestinal parasitic worms in different parts of the Philippine Islands, including Manila; Taytay, Rizal; Las Piñas, Rizal; Tuguegarao, Cagayan; Santa Isabel, Isabela; Baguio, Benguet; and San Antonio and Malauno, Isabela. In all, 19,302 persons have been examined, of whom 16,535, or 85.66 per cent, were found with single or multiple infections with verminous parasites. Cases of infection with the rarer worm parasites and at least one new species have been discovered. Investigations have been made on trichocephaliasis and on the etiology, pathology, symptomatology, and treatment of paragonimiasis in the Philippines. The efficient prophylaxis against certain worm parasites depends upon a knowledge of their complex life histories, especially of that part of their development which takes place outside of man. With this



1. Early ulcer with necrotic cap.
2. Ulcer with necrotic tissue removed.
3. Confluent ulcer.

PLATE V. UNUSUAL CASE OF AMŒBIC DYSENTERY.

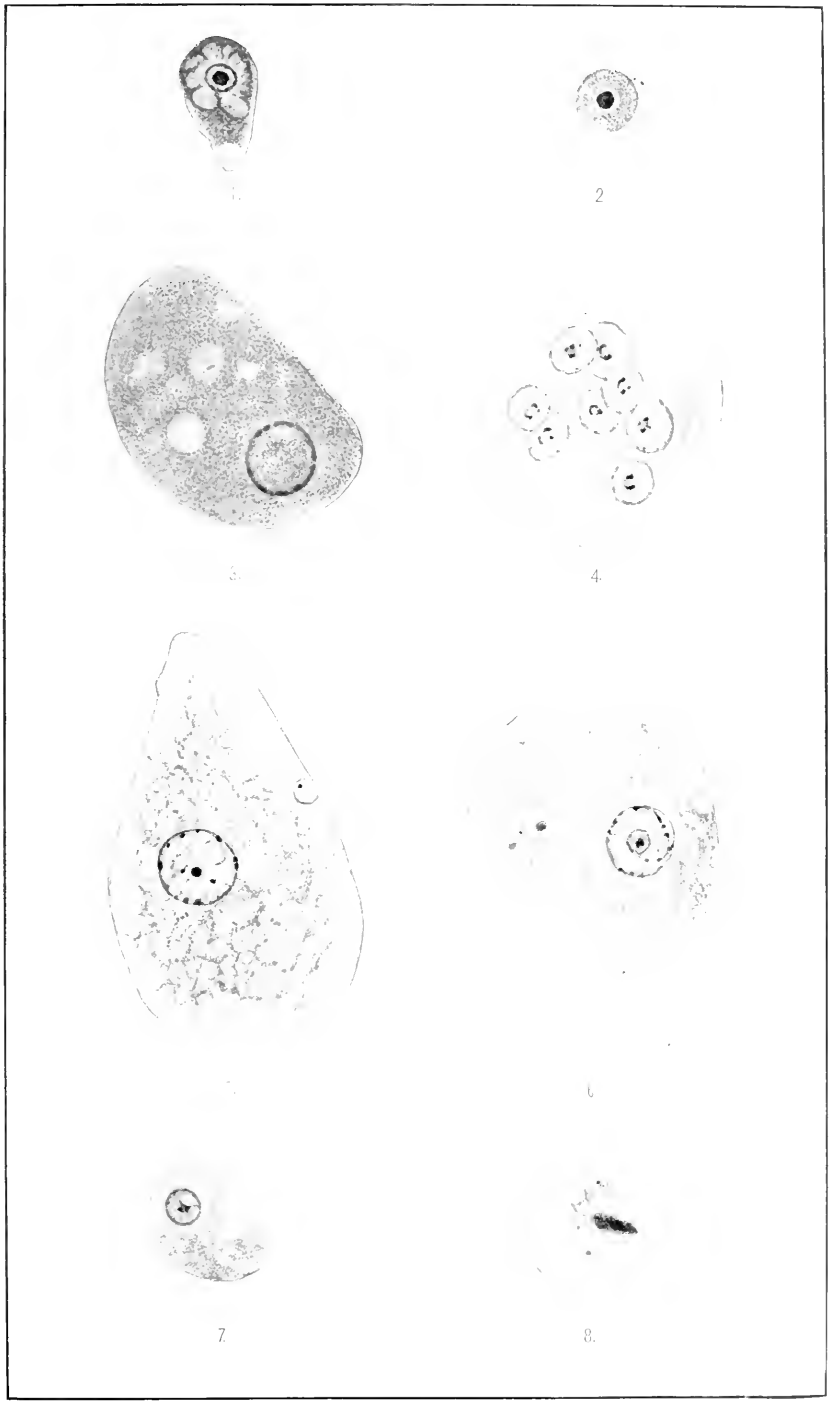


PLATE VI. TYPICAL EXAMPLES OF AMŒBA AND ENTAMŒBA.

PLATE VII. SECTION OF LARGE INTESTINE OF MONKEY, SHOWING A SINGLE BALANTIDIUM COLI SUIS UNDER THE HEALTHY INTESTINAL EPITHELIUM.

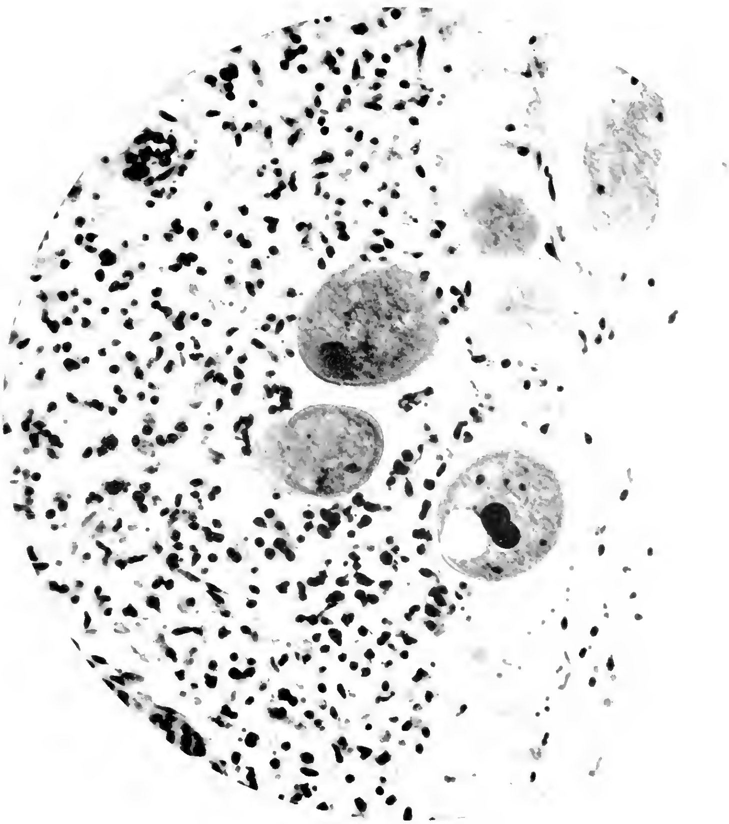


PLATE VIII. SECTION OF A MESENTERIC LYMPH GLAND OF MONKEY, SHOWING SEVERAL BALANTIDIUM COLI HOMINIS IN THE EDGE OF THE GLANDULAR TISSUE.

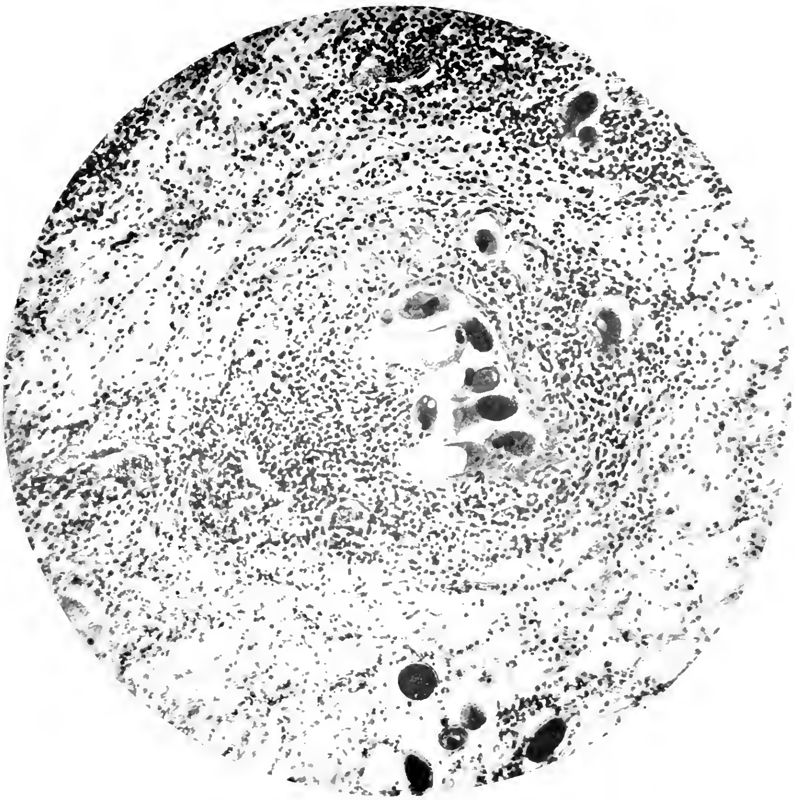
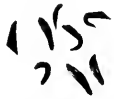


PLATE IX. SECTION OF THE LARGE INTESTINE OF A MAN DEAD FROM BALANTIDIAL DYSENTERY.



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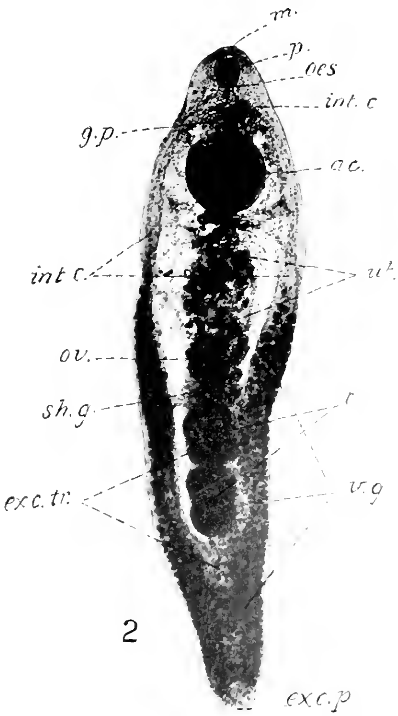

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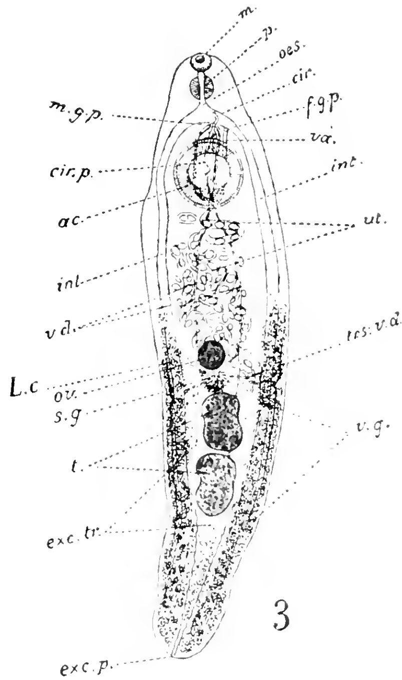

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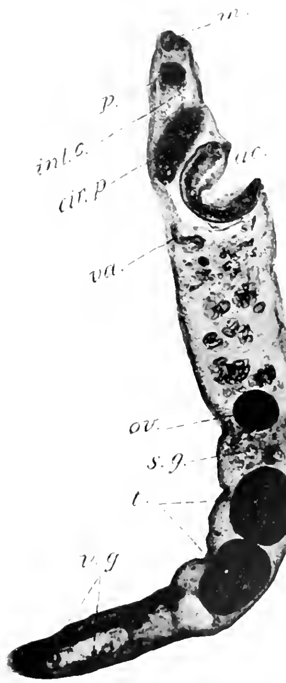

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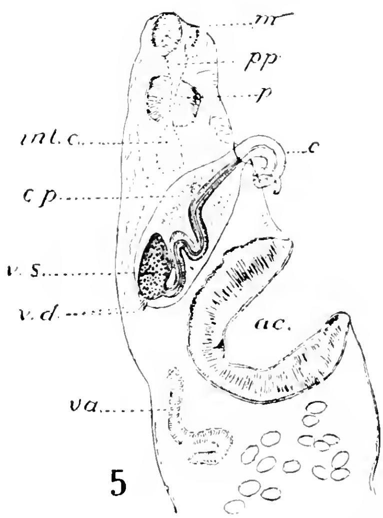

5

PLATE X. AN INTESTINAL TREMATODE OF MAN.

knowledge in view, studies have been made of the development and life history of *Paragonimus* and *Œsophagostomum* (see page 49).

12. *Yaws.*—The occurrence and distribution of yaws and the histology of the lesions of this disease have been investigated, and three years ago a specific cure for yaws was discovered. Dr. Paul C. Freer describes this on pages 13 and 14 of the Tenth Annual Report as follows:

> Ehrlich and his pupils had found that dioxy-diamido-arsenobenzol had produced very favorable results in the treatment of fowl spirochætosis and syphilis and, therefore, the idea suggested itself to try the remedy in yaws, because of the morphologic and biologic relationship which exists between the spirochætæ giving rise to yaws and syphilis respectively. It was found that dioxy-diamido-arsenobenzol is an ideal specific for yaws. Three or four days after the injection of the drug, the granulomatous lesions begin to improve and in the course of from ten to twenty days they usually have disappeared entirely, leaving a perfectly smooth, pigmented skin where the lesions previously existed. The absorption of tumor masses measuring several centimeters in diameter and about a centimeter in thickness in so short a time, and under the influence of no local treatment, is very striking and surprising. Indeed, in the severe cases the disappearance of the lesions and the cures produced can most aptly be spoken of as marvelous. Even large granulomatous masses or deep ulcerations heal within from two to four weeks. No more striking example in medicine is known than that of the specific action of dioxy-diamido-arsenobenzol on the lesions of yaws. It would appear that this chemical individual is as important a specific for yaws as quinine is for malaria. Therefore, a fourth specific in medicine has been discovered.

13. *Beriberi.*—This oriental disease is prevalent in the Philippines, and the deaths from beriberi among residents of Manila during the years 1910, 1911, and 1912 were more than the deaths from tuberculosis of the lungs and far more than the combined deaths from cholera, smallpox, bubonic plague, and typhoid fever during the same period. Investigations first undertaken by this Bureau have demonstrated that the excessive infant mortality in these Islands is chiefly due to infantile beriberi. Extensive experiments on man made by this Bureau with different diets—including red, or polished, and white, or decorticated, rice—have proved that beriberi is a disease of nutrition and not an infection, and have demonstrated that white or decorticated rice, which is the staple article of diet of the Filipino, is the chief cause of the prevalence of the disease in the Philippines. It has been demonstrated that it can be prevented by the use of unpolished rice instead of polished or decorticated rice, and by this means the disease has been eradicated from all Philippine Government institutions.

14. *Animal diseases.*—The animal diseases investigated by the biological laboratory of this Bureau include hæmorrhagic septicæmia, glanders, bronchopneumonia, surra, piroplasmosis, and rinderpest. The preparation of antirinderpest serum and investigations of rinderpest virus and serums and tests of the efficiency of treatment with serum by the simultaneous method with virus and serum have been carried on. The treatment of surra with Ehrlich's new trypanocide, arsenophenolglycin, was tested in a considerable series of experiments in the laboratory and in the field by members of the staff, with better results than had before been secured with other drugs or chemicals.

15. *Pathology and histology.*—Besides the study of the pathology of the tropical diseases, much special pathological investigation has been performed upon abnormal and morbid conditions found in the course of many hundreds of autopsies. A large series of histological examinations has been made upon material from the surgical clinic of the Philippine General Hospital.

16. *Immunity and tropical sanitation.*—Substantial contributions have been made to the theory and practice of immunity. The immune sera and bacterial products used in the therapy of, and immunization against, infectious diseases prepared in the serum laboratory of this Bureau and used for vaccination against smallpox; antirabic treatment; bacterial inoculation against cholera, plague, and typhoid; serum treatment of diphtheria and tetanus; etc. have played no inconsiderable part in the sanitation of the Philippines. Furthermore, numerous researches have been contributed to our knowledge of the preparation, application, and efficiency of serum and vaccine immunity and treatment of diseases.

Back of all executive work and the application of scientific measures for sanitation stands the laboratory, which must make the diagnosis, develop the principles of scientific sanitary measures by experiment, and test the efficiency of the results. The results of this work have assisted in reducing the death rate of the tropical city of Manila below that of many cities in Europe and the United States. The hundreds of thousands of laboratory examinations and diagnoses of infectious diseases, the preparation of protective and curative sera and vaccines, and the bacteriological examination of water supplies have contributed immeasurably to this sanitary improvement.

17. *Mosquitoes.*—Experiments at Olongapo, the United States naval station, demonstrated the transmission of malaria by the most prevalent species of anopheline mosquito of the Philippine

Fig. 1.

Fig. 2.

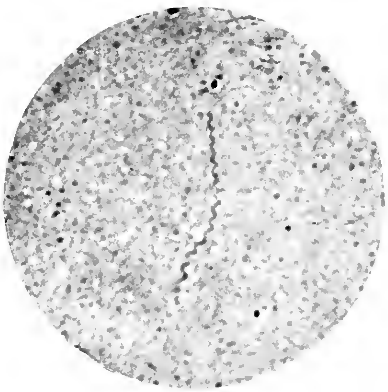

Fig. 3.

Fig. 4.

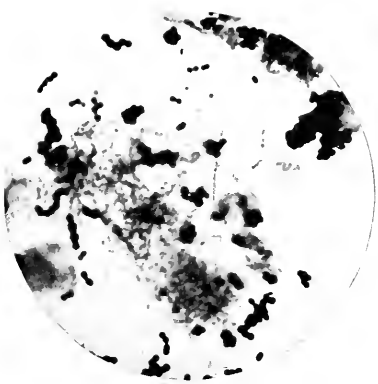

Fig. 5.

Fig. 6.

PLATE XI. TREPONEMA PERTENUIS CASTELLANI OF YAWS.

Fig. 1 Case I, before treatment.

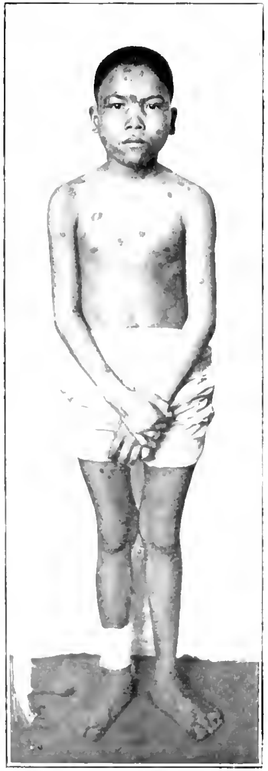

Fig. 2. Same after treatment.

Fig. 3. Case II, before treatment.

Fig. 4. Same after treatment.

PLATE XII. THE SPECIFIC CURE OF YAWS WITH DIOXY-DIAMIDO-ARSENOBENZOL.

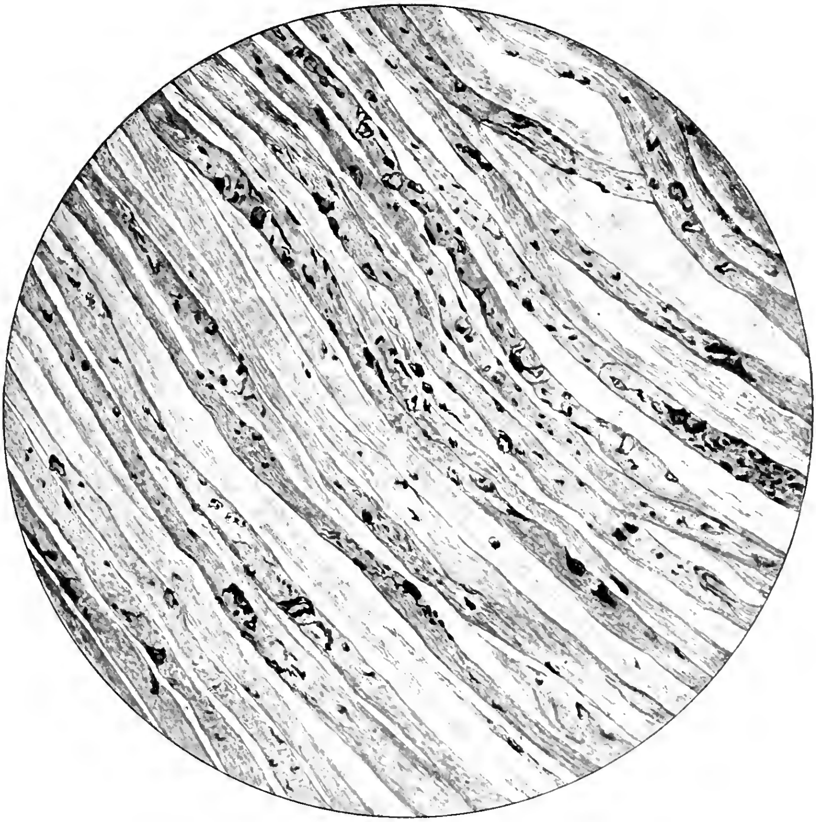

PLATE XIII. LONGITUDINAL SECTION OF VAGUS NERVE.

Fig. 1.

Fig. 3.

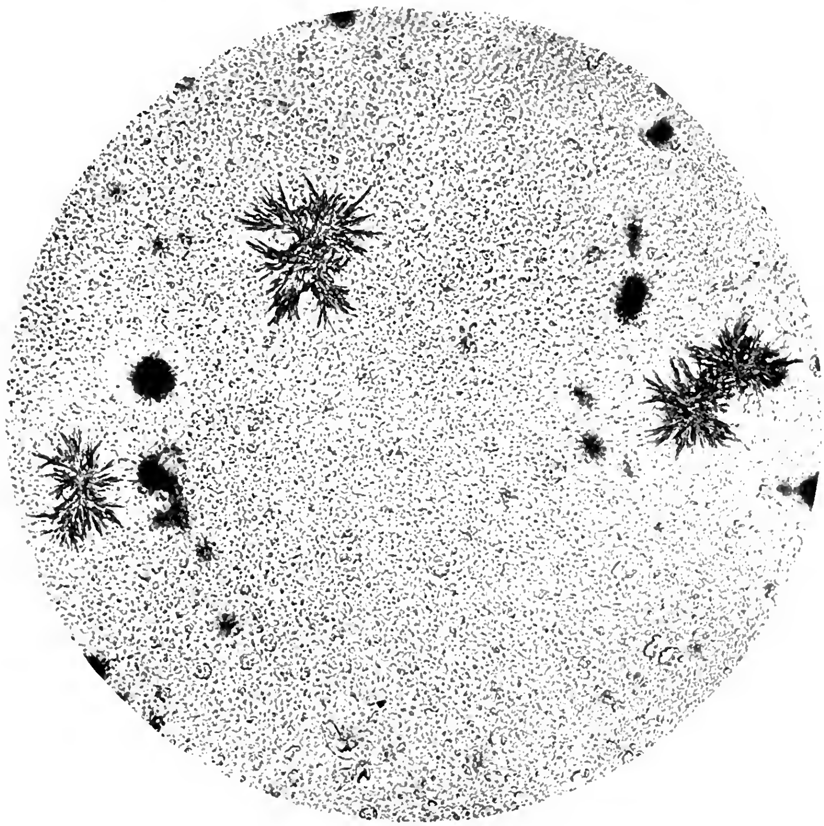

Fig. 2.

PLATE XIV. ETIOLOGY OF MYCETOMA.

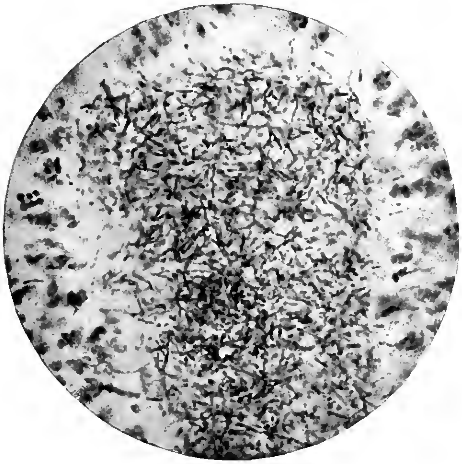

Fig. 1.

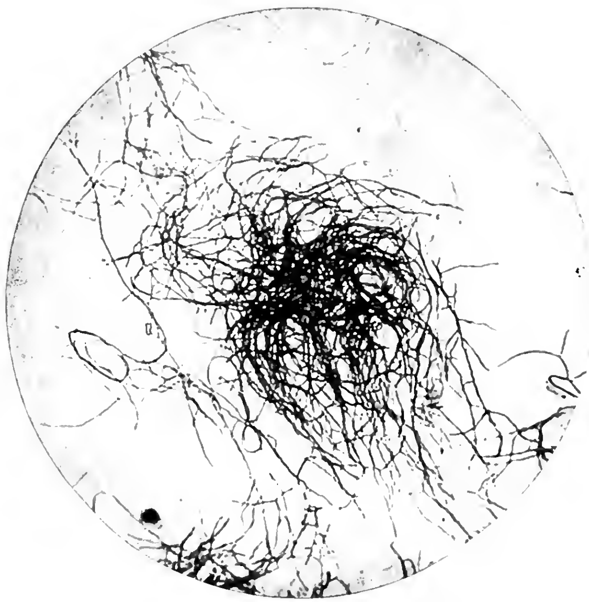

Fig. 2.

PLATE XV. STREPTOTHRICOSIS WITH SPECIAL REFERENCE TO THE ETIOLOGY AND CLASSIFICATION OF MYCETOMA.

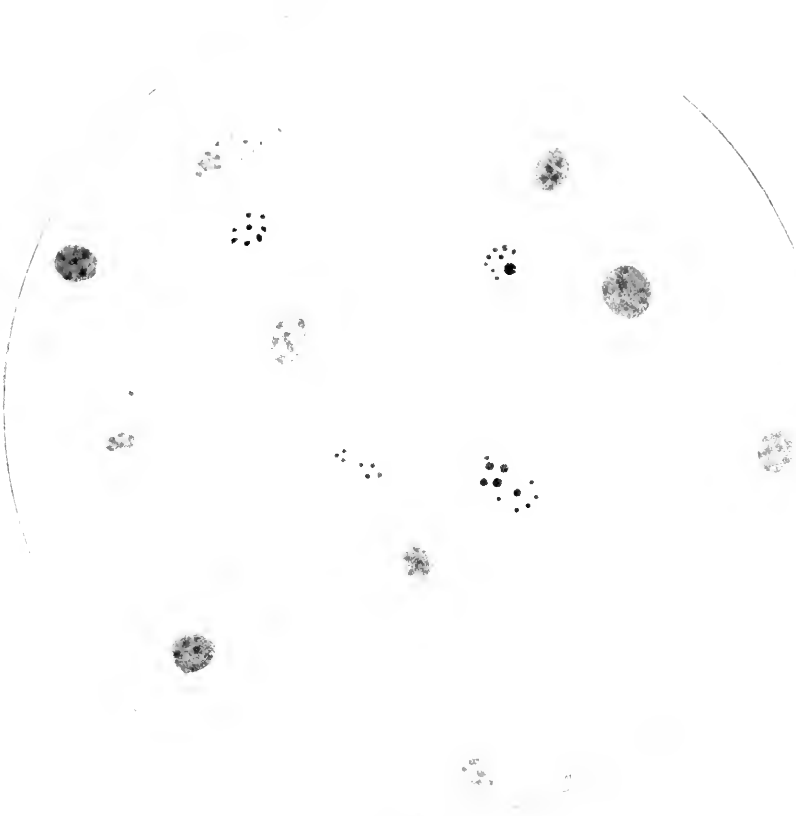

PLATE XVI. HYDROPHOBIA IN THE PHILIPPINES.

Fig. 1.

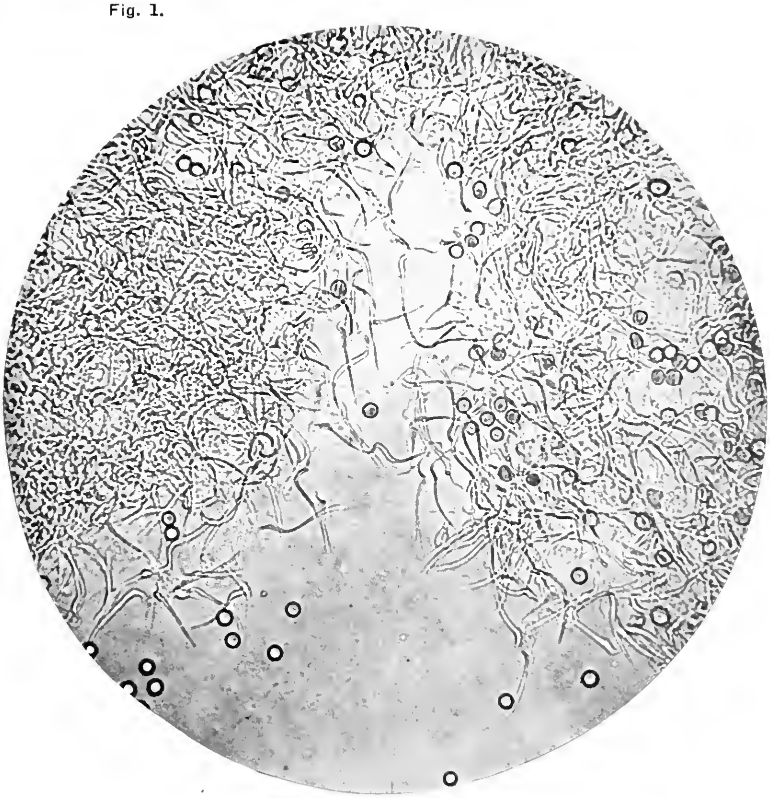

Fig. 2.

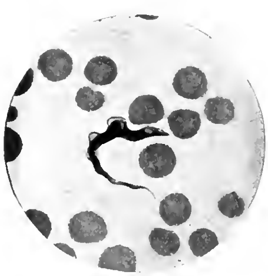

Fig. 3. Fig. 4. Fig. 5.

PLATE XVII. STAGES OF A PIROPLASMA AND OF A TRYPANOSOMA OF CATTLE AND THE SCHIZOGONY OF TRYPANOSOMA EVANSI IN THE SPLEEN OF THE VERTEBRATE HOST.

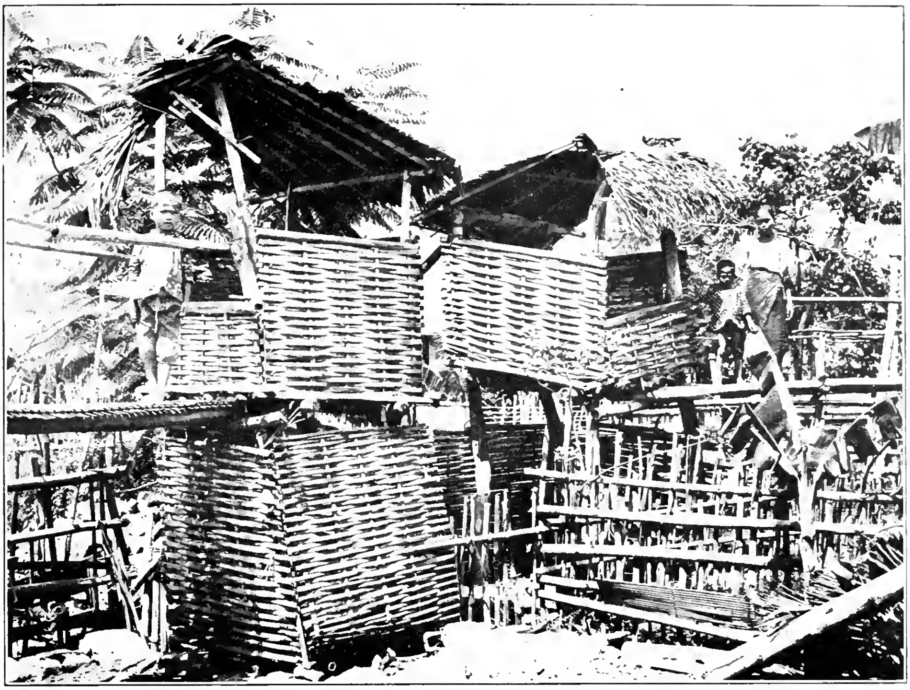

Fig. 1. Typical outhouses.

Fig. 2. Outhouse in proximity to well.

PLATE XVIII. MEDICAL SURVEY OF TAYTAY.

Islands, and sanitary measures looking to the eradication of this mosquito have been put into effect, especially in Manila, Iloilo, and Baguio, with results that can certainly never be estimated or even approximated in money.

The eradication of the night mosquito (*Culex fatigans*), known to carry filaria and to be a possible factor in dengue fever, has been practically accomplished in Manila, Iloilo, and Baguio, and Manila is free from this pest at the present time. As soon as recommendations by us as to filling, draining, and building precautions are complied with, Manila will be a mosquito-free town.

18. *Household insects.*—The pests of the household, such as cockroaches, bedbugs, lice, and fleas, while present in all civilized countries, are especially numerous in tropical countries owing to climatic conditions favoring their uninterrupted multiplication. Advice has been given as to the most approved means of attacking these pests.

19. *Flies.*—While a pest to the householder, flies are really more of a community insect in that they usually breed on common dumping grounds of horse manure and garbage and in certain articles in process of manufacture. Successful campaigns under the direction of this Bureau have been waged against this insect in Manila, Iloilo, Baguio, and Aparri.

20. *Animal parasites.*—Our investigations have suggested measures for the protection of cattle, carabaos, horses, dogs, and other domestic animals from the parasites that infest them. The Australian and not the American species of cattle tick is the one commonly found in these Islands. Means of preventing human myiasis frequently have been recommended.

21. *Termites.*—In the Philippines as in all other tropical countries, termites ("white ants") do incalculable damage to commercial timbers of many kinds and to buildings constructed in whole or in part of wood. They perform a wonderful and little-known function in the rapid consumption of fallen timbers in the forest, thus making room for new growth. The only feasible methods of combating these pests are to use timbers impregnated with some repellent, such as crude petroleum and coal-tar products, and to destroy the underground nests in the vicinity. No remedy except the removal of infested material is known for termites once they get into sidings, moldings, ceilings, and the like. Many private as well as public buildings in Manila and in the provinces have been freed from this pest by the methods suggested above.

22. *Locusts.*—The so-called locust fungus was used by this Bureau as early as 1901, as well as *Coccobacillus acridiorum*

d'Herelle during the past few months, in experiments against locusts in various parts of the Philippines, but neither has been effective in exterminating the insects. As early as 1905 recommendations looking to the establishment of the present method of combating this pest were made to the Executive Secretary and the Director of Agriculture, and resulted in the present laws with reference to the matter.

23. *Tobacco pests.*—Tobacco is attacked in the field by the tobacco worm and plant lice, and it has already been demonstrated that hand picking is the only sure and cheap way of combating the former of these pests while the latter may be held in check or practically eradicated by spraying with a weak kerosene emulsion which in no way injures the leaf. Data concerning, and remedial measures which may be applied in various tobacco factories in Manila for combating, the cigarette beetle have been furnished. If these suggestions had been followed during the past three years in the 19 factories in Manila, which have an export trade, there would have been a net saving of over ₱39,000 on the losses which occurred for cigars actually destroyed in the factories alone, not considering the loss of stock outside of the factory due to the same cause or to loss of trade due to the shipment of infested stock.

24. *Cacao insects.*—It has been shown that the most effectual means of controlling cacao insects is that of clean culture in the cacao orchards, together with the use of repellent substances to keep away the borers liable to attack the trunk, and the spraying of fruits and leaves for biting and sucking insects. There is no place in these Islands so far as known where this crop has been given even semiscientific attention, although it is one of the most promising of the many crops.

25. *Rice insects.*—In the field, rice is attacked seriously by four different insects; namely, locusts, the rice army worm, the rice stem borer, and the *tiañgao,* an insect which sucks the milk from the setting grain. It has been shown that these insects have their regular times of development and that their ravages can be lessened by changing the time of planting rice so as to avoid having it in a condition of susceptibility when the insects are at the stage when they attack. Some farmers have profited by this procedure, but as this can only be brought about by the use of irrigation general relief cannot be looked for until irrigation is commonly practiced.

Stored rice is subject to the attacks of weevils, and this can be prevented by properly constructed receptacles. The weevils

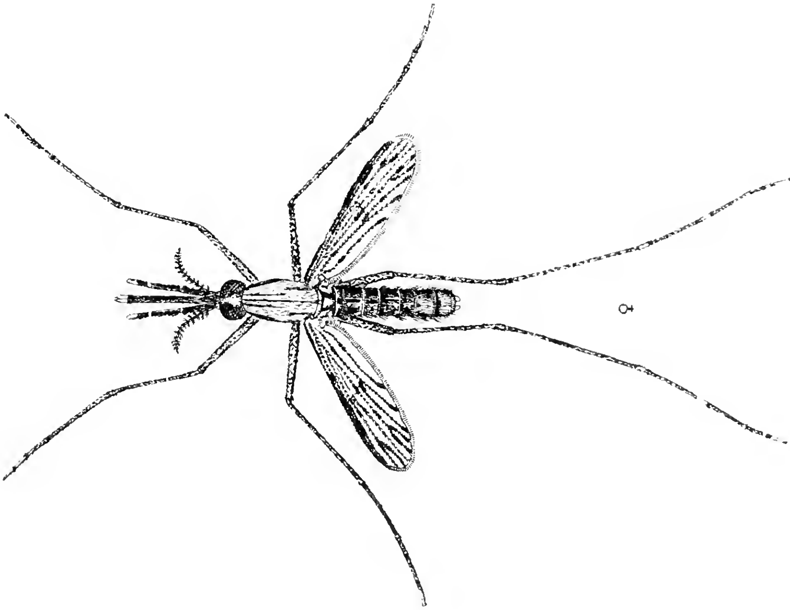

Fig. 1. Adult female of Myzomyia ludlowii Theob. × 8.

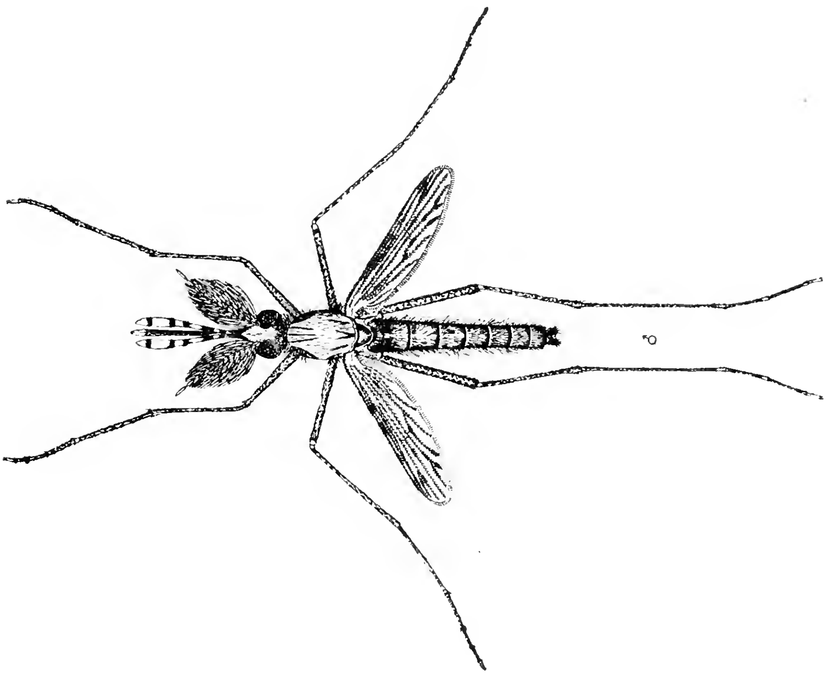

Fig. 2. Adult male, same. × 8.

PLATE XIX. EXPERIMENTS IN MALARIAL TRANSMISSION BY MEANS OF MYZOMYIA LUDLOWII THEOB.

Fig. 1. A queen termite in the queen cell. Natural size.

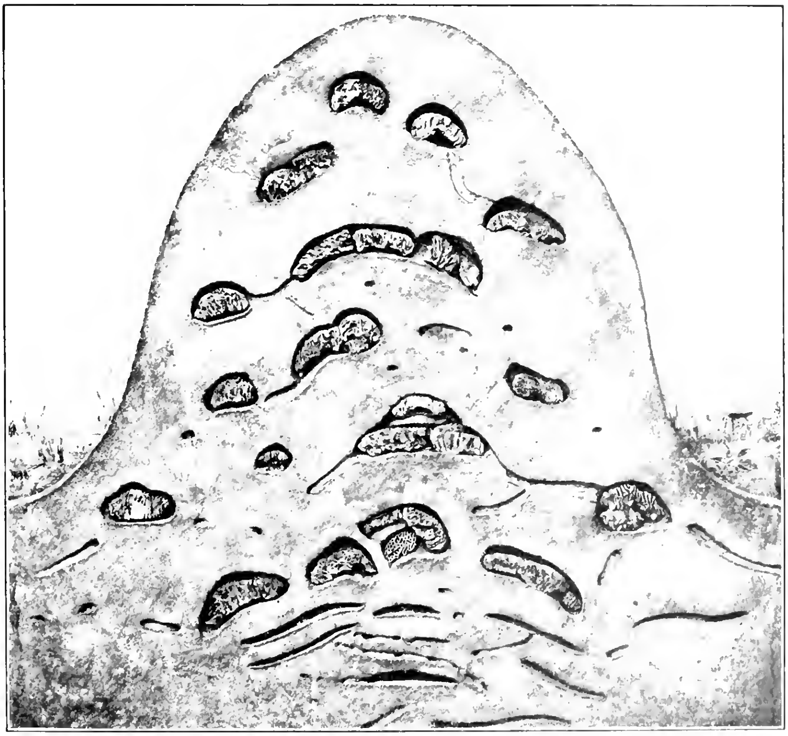

Fig. 2. Model of a cross section of a termite cone.

PLATE XX.

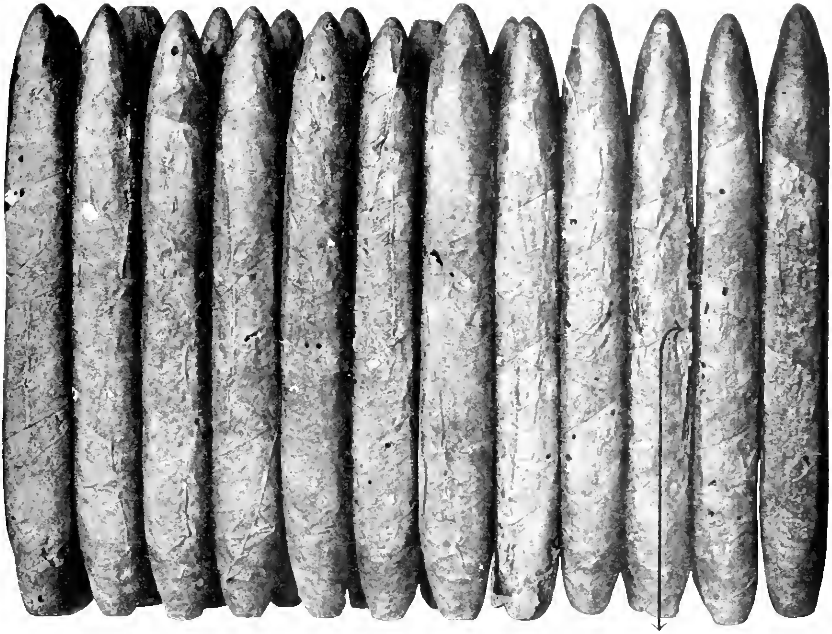

Fig. 1. Cigars showing infestation by cigarette beetles; (*a*) character of injury where a larva gets between two cigars.

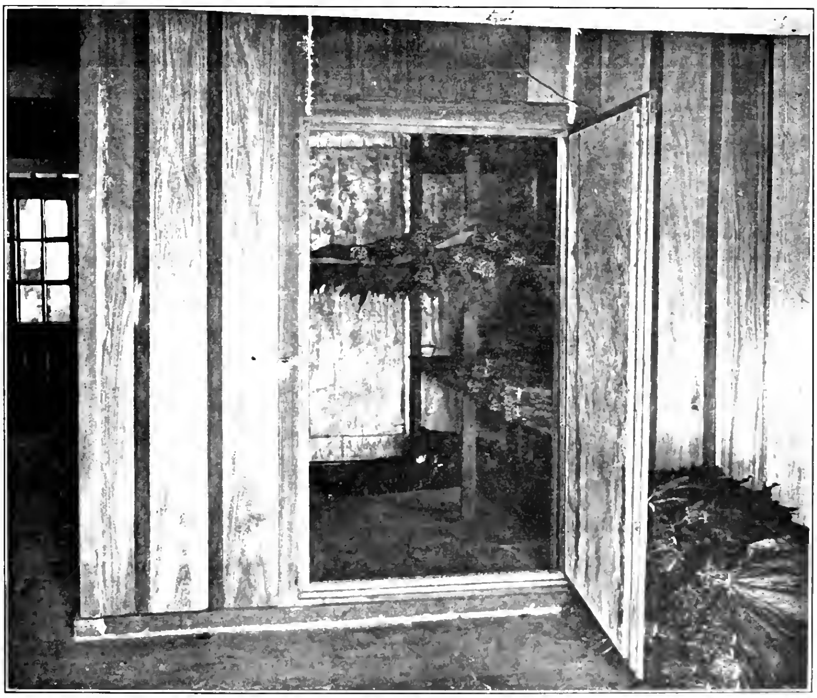

Fig. 2. Fumigating-compartment, showing tobacco wrapper on shelves.

PLATE XXI.

Fig. 1. Freshly painted doors of a bodega, showing adult cigarette beetles.

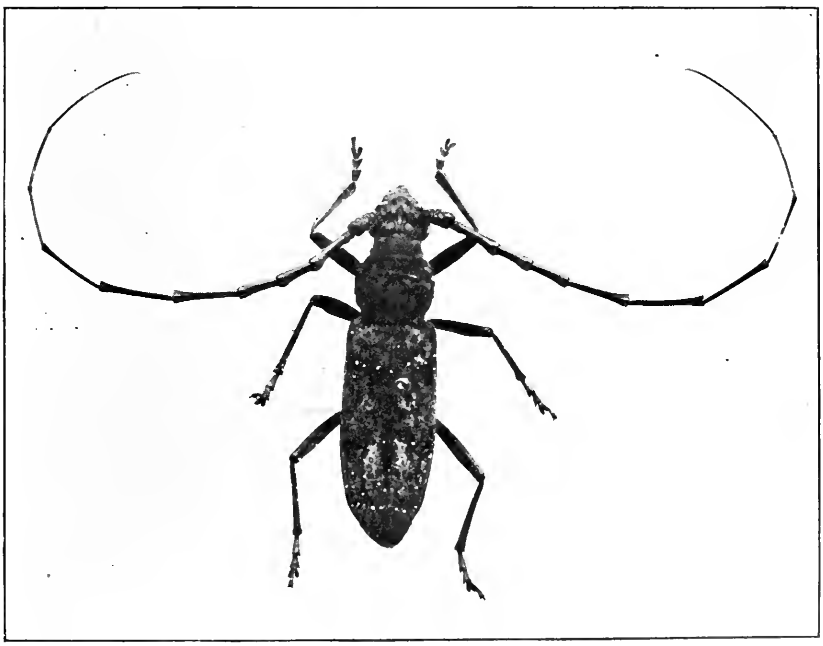

Fig. 2. Cerambycid, adult.

PLATE XXII.

Fig. 1. Interior of a silk house, showing ant-proof racks for the silkworms.

Fig. 2. Silk-reeling exhibition at the Philippine carnival.

PLATE XXIII.

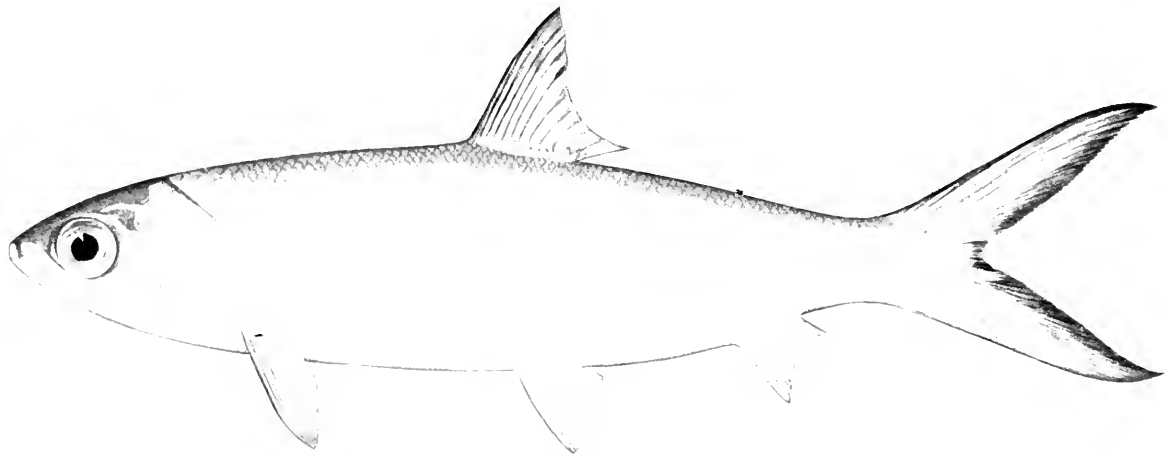

PLATE XXIV. BAÑGOS. MILKFISH (FAMILY CHANIDÆ). CHANOS CHANOS (FORSKÅL).

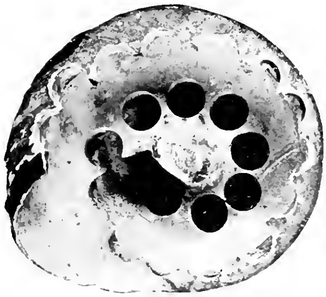

Fig. 1.

Fig. 2.

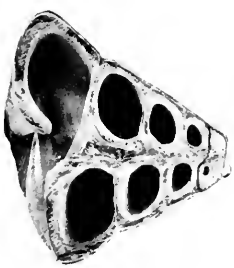

Fig. 3.

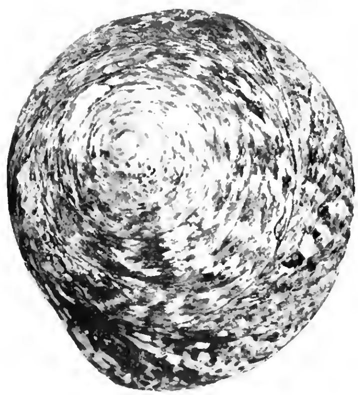

Fig. 4

PLATE XXV. FISHERY RESOURCES OF THE PHILIPPINE ISLANDS.

can be killed by fumigation with carbon bisulphide or hydrocyanic acid gas.

26. *Garden and field crop insects.*—A very large amount of miscellaneous information is on record in this Bureau and has been disseminated regarding the prevention of the ravages of pests of garden products, such as, cabbage, asparagus, camotes, peas, corn, beets, radishes, and cucumbers; and the many purely native crops, such as, *gabi, ubi, camoting-cahoy, calabasa,* and *upo.*

27. *Silk culture.*—This Bureau introduced the culture of the polyvoltine silkworm of Ceylon in the Philippine Islands, and, besides developing a Philippine race producing at least eight generations a year, has definitely established the fact that the Japanese monovoltine silkworm cannot be acclimated here. The eri silkworm will thrive here, and an abundant supply of food for this insect exists in the castor oil plant commonly growing wild throughout the Islands.

28. *Marine biology.*—A beginning has been made in the important branch of biology which includes the study of marine products; such as, pearl oysters, window shell, edible mollusks, and edible fishes. A number of important groups of marine animals are being studied systematically, and among the more technical papers on this subject may be mentioned those on the anatomy of *Aclesia freeri* and of *Euplotes worcesteri,* the habits of fiddler crabs, and the descriptions of new species of fishes. When a sufficient amount of systematic work has been completed, we shall have a substantial basis for extended economic work and for the development of the fisheries industries.

29. *Fishery resources.*—The fishes commonly used as food have been identified, and their abundance and value noted.

A study has been made of the varieties of commercial sponges found in the Islands, and suggestions published with regard to their artificial propagation.

The species of pearl-producing mollusks have been identified, a study has been made of the existing pearling industry, and a modification of existing laws governing pearl fishing has been suggested.

Other marine products that have been studied include trepang, sharks' fins, tortoise shell, window shell, shells for buttons, precious coral, edible seaweeds, and isinglass.

30. *Ethnology.*—Our published researches in ethnology have increased the information concerning the social organizations, languages, beliefs, manners and customs, and the territory

occupied by, and the approximate number of individuals which compose, the non-Christian tribes, and have assisted in their material prosperity and their advancement in civilization.

A very comprehensive study has been made of the Ifugaos and is now in manuscript. Parts of this have been printed in papers on the harvest feast and the burial ceremony of the Kiañgan Ifugaos. Several tribes have been studied to ascertain the best methods for aiding and protecting them and for advancing their civilization. Some of the results obtained in this way have been embodied in papers on the Mañgyans of Mindoro, the Tingians of northern Luzon, the Bagobos of Davao Gulf, the Bataks of Palawan, and the non-Christians of Ambos Camarines.

Ethnology includes the study of Christian people as well as of non-Christians. Along this line a careful study of the Ilocanos has been carried on. In advance of a complete report on this subject, papers on the stone industry at San Esteban and the woodworking industry of San Vicente have been printed.

31. *Philippine museum.*—The museum of this Bureau on Calle Juan Luna contains material illustrative of the culture of most of the various groups of the Filipinos. The articles now in the museum represent the culture of the Bontocs, the Ifugaos, Isinays, Kalingas, Tingians, Mandayas, Mañgyans, Moros, Manobos, Bagobos, Yakan Moros, Subanuns, and Tirurais among the uncivilized peoples and the Ilocanos among the Christian people and a few scattered objects from odd groups. As soon as we have similar collections from the Visayans, Bicols, and Tagalogs, our collections will be fairly comprehensive and illustrative of the culture of the various groups of Filipinos.

One-half of the first floor of the museum building has been given up to the Bureau of Forestry for an exhibit of Philippine woods. The most complete and most interesting collection of Philippine woods to be seen anywhere is on exhibition here in the form of planks and logs.

Among the Bureau of Science exhibits worthy of special note are: A collection of hats, both those formerly in use and those worn at the present time; traps from various parts of the Islands for catching fish and crabs; extensive collections of weapons and implements from the Moros, Manobos, Mandayas, Ifugaos, Bontocs, and Igorots; cloths from Mindanao and from northern Luzon; basket work from the Manobos, Yakan Moros, Ifugaos, and Bontocs; and stone and silver work from the Ilocanos.

We have also a collection of Japanese and of Australian sponges, of rubber from the Straits Settlements, of Philippine

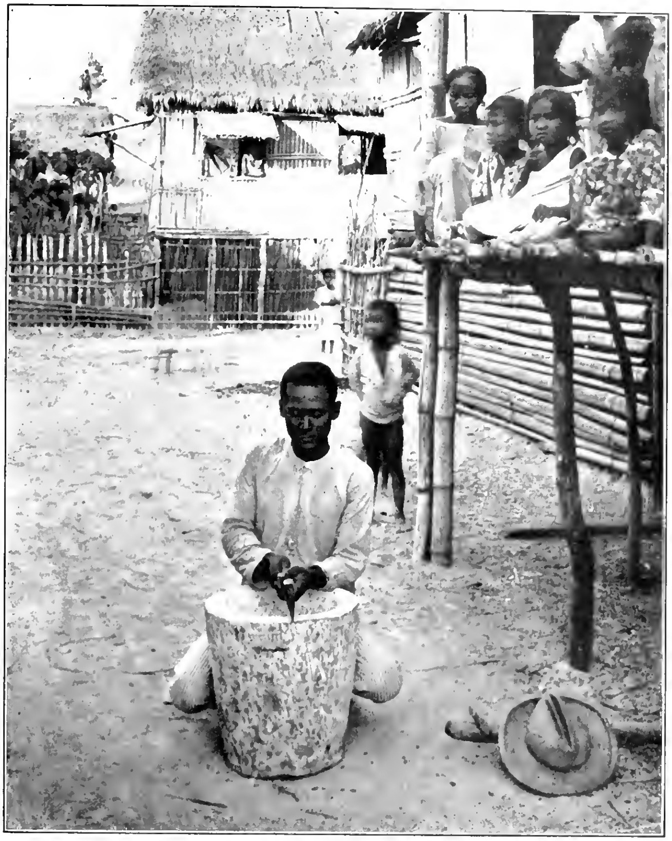

Fig. 1. Finishing a rice mortar.

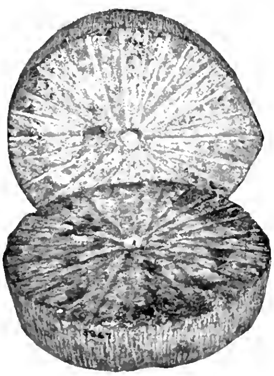

Fig. 2. Corn mill.

Fig. 3. Corn mill.

PLATE XXVI. THE STONE INDUSTRY AT SAN ESTEBAN, ILOCOS SUR.

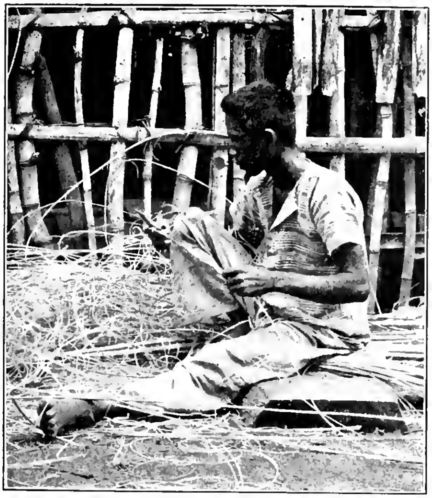

Fig. 1. Man preparing rattan.

Fig. 2. Girl putting the rattan seat and back in a chair.

Fig. 3. Men making a bed.

PLATE XXVII. THE WOODWORKING INDUSTRY OF SAN VICENTE, ILOCOS SUR.

Fig. 1. Second story of museum, looking north from the center.

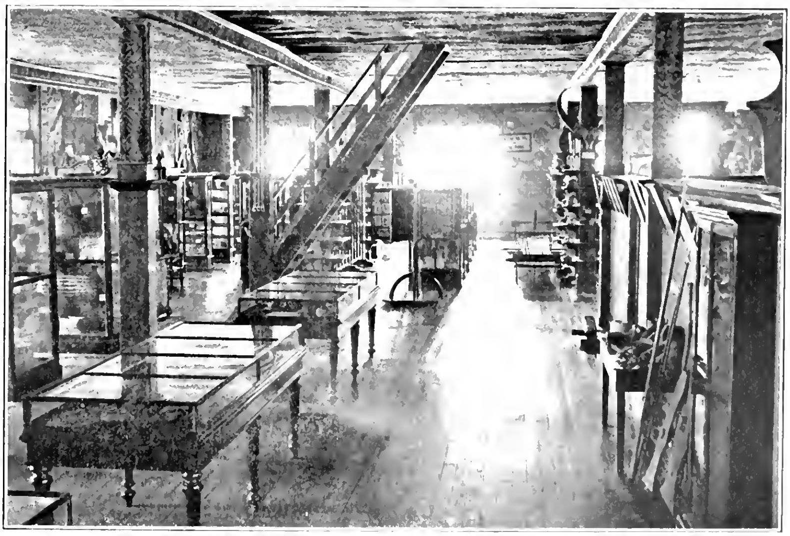

Fig. 2. Second story of museum, looking south from the center.

PLATE XXVIII.

pottery and silk, and of various chemical products from Philippine materials.

32. *Natural history specimens.*—This Bureau has established and developed the most extensive collection of Philippine birds, plants, insects, snakes, fishes, shells, and marine invertebrates extant. Many of the specimens are very beautiful, and often suggest designs for ornamentation and decoration. Their distribution may indicate climatic conditions, the course of storms and ocean currents, or the quality of the soil.

33. *Herbarium.*—The Bureau of Science is the center of botanical work on the Philippine flora. Its herbarium, which is a great card catalogue of Philippine botany from the standpoint of both systematic and economic botany, possesses the largest collection of Philippine plants extant, about 75,500, while the foreign material, chiefly from the Indo-Malayan region, brings the total collection up to about 119,000 specimens. Additions are being made at the rate of from 12,000 to 15,000 annually. The collection contains specimens of practically all the species of plants definitely known from the Archipelago, including a very large number of types and cotypes; that is, the actual specimens or duplicates of specimens on which the original descriptions of species were based.

The collections of the Bureau of Science include not only the flowering plants and ferns, but also the lower groups—mosses, scale mosses, lichens, fungi, and algæ. The market value of our present collections is at least ₱30,000, while the scientific value is infinitely greater and cannot be estimated.

34. *Economic botany.*—The subject of economic botany comprises all our coöperative work of a botanical nature with such bureaus as those of Forestry, Agriculture, and Education; the identification and regional distribution of timber trees and plants of agricultural importance; medicinal plants and investigations of the same; fiber plants; dyes and tans; oil-producing plants; those yielding gums and resins; those used in industrial work; and plant diseases and their control. Data on the constituent species of the Philippine flora, their distribution, occurrence, uses, native names, etc. are compiled in the herbarium of the Bureau of Science. The botanist is able, from an examination of our botanical records, to indicate what plants are already known from the Philippines, where they occur, when they produce flowers and fruits, their properties to a certain degree, their native names, etc.; and what plants of other tropical countries will probably thrive in the Philippines, and under what conditions

as to altitude, moisture, etc., if once introduced, and those that will probably not thrive here. A large amount of strictly economic botanical work is accomplished each year for this and other bureaus and for various individuals.

35. *Systematic botany.*—Numerous papers have been published on the botanical collections of the Bureau both by employees of the Bureau and by specialists to whom material has been sent for study and report. The total number of species of vascular plants known from the Philippines has been increased by about 2,500 in the few years that botanical work has been in progress here, so that we know at present from the Archipelago about 7,000 species. The development of the systematic work here has been necessary to the advancement of our definite knowledge of an infinite number of problems bearing on forestry, agriculture, and education. No American botanical institution is sufficiently equipped in botanical material, literature, or personnel thoroughly to cover the Philippine field, and the few European institutions so equipped are busy with the floras of other regions. The results of our systematic work, so far as the flora of the settled regions is concerned, are given in A Flora of Manila.

In connection with this work, botanical exploration is absolutely necessary, in order that we may determine what plants are found in the Philippines, whether they are of wide distribution or are of local occurrence, their habitats, and other important data. So far as practicable, it is planned to send collectors into regions that are little known botanically; that is, where no comprehensive botanical collections have previously been made. A great amount of botanical material is thus secured each year, of which the first set is deposited in the herbarium of the Bureau and the duplicates disposed of to other institutions in exchange for botanical material from other countries. Botanical exploration must precede practical application.

36. *Botanical identifications.*—Identifications of botanical material are made amounting to some thousands of specimens annually for the Bureaus of Forestry and Education and the College of Agriculture, and to a limited extent for the Bureau of Agriculture. It is impossible to estimate the financial value of these identifications. The privilege is open to all bureaus.

37. *Mycology.*—These investigations are most important from an economic standpoint. They include the collection and determination of the different kinds of fungi, and the special branch, vegetable pathology, which comprises the study of the fungi causing the diseases of plants and methods of preventing and

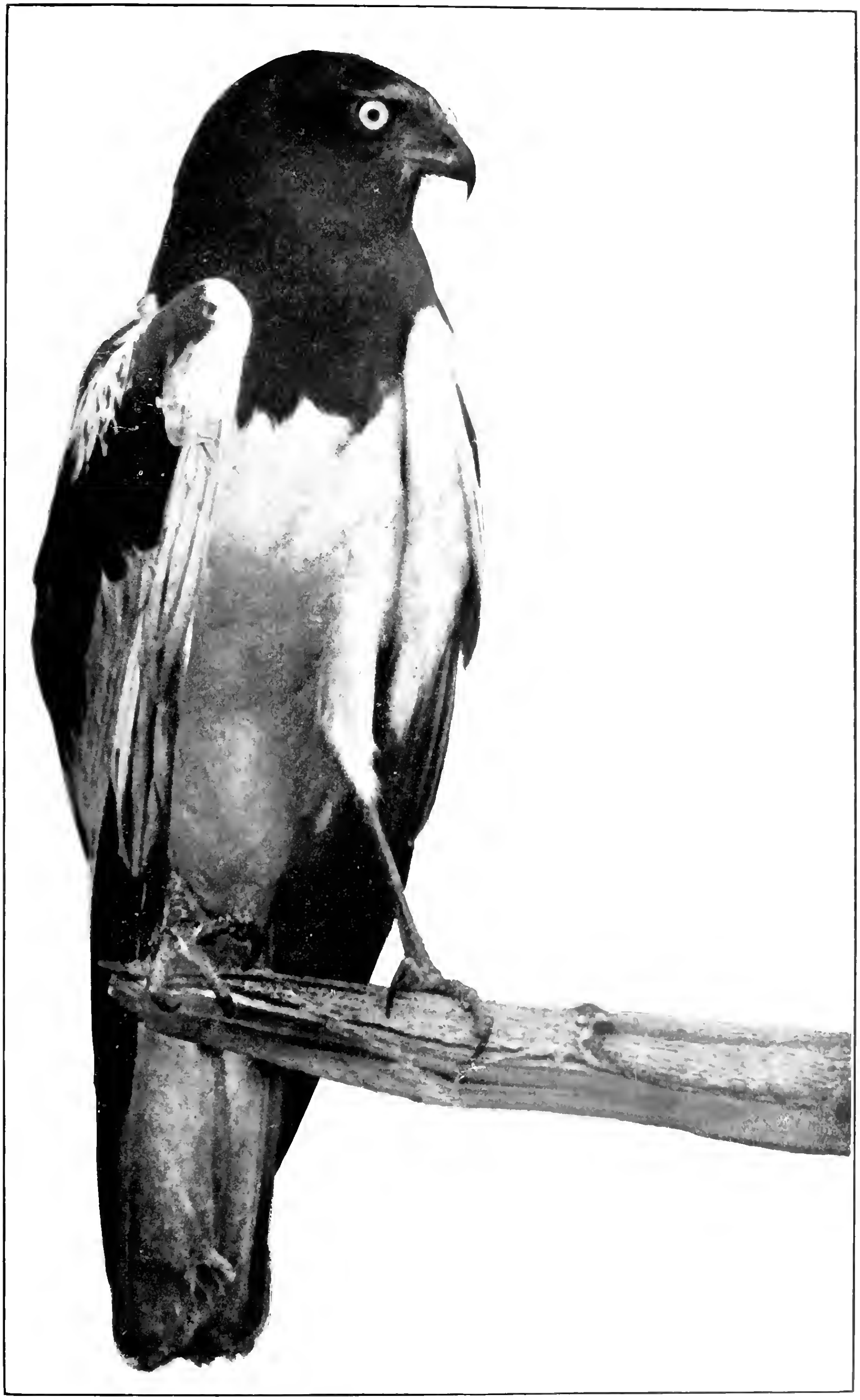

PLATE XXIX. CIRCUS MELANOLEUCUS (FORSTER).

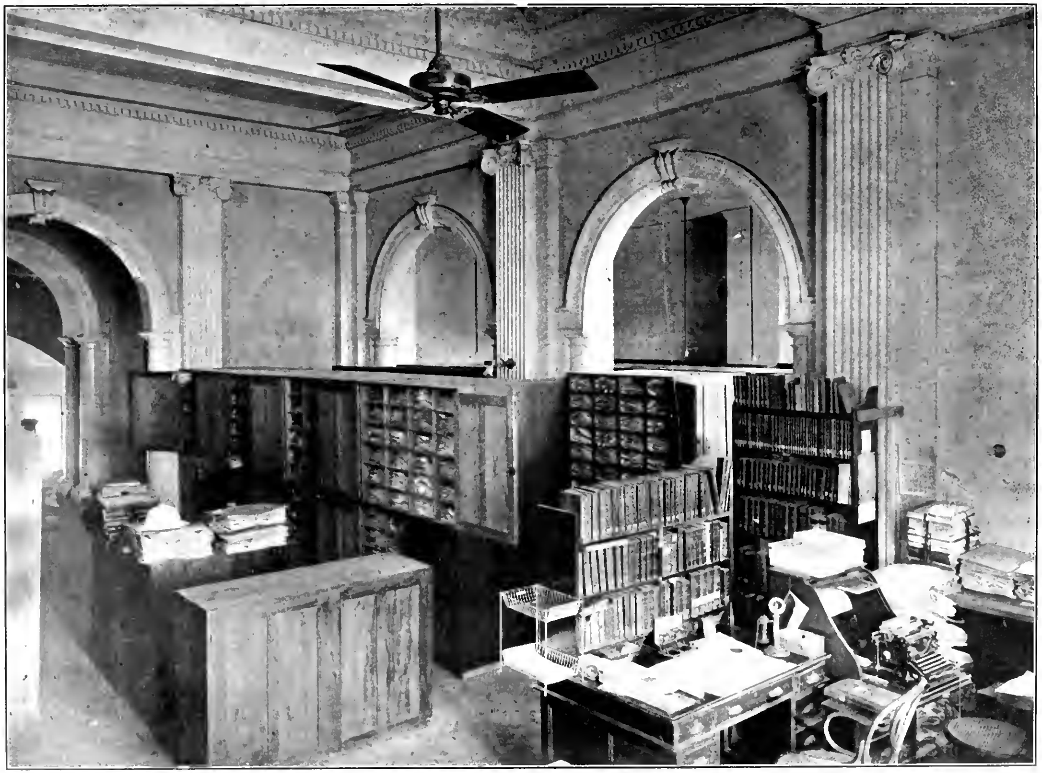

PLATE XXX. INTERIOR OF HERBARIUM, SHOWING TYPE OF CASES.

PLATE XXXI. TRUNK OF AN ALMACIGA TREE (AGATHIS ALBA FOXW.).

eradicating such diseases. The inspection and fumigation of imported plants, cuttings, seeds, etc., are intimately connected with this subject and are necessary in order to prevent the inadvertent introduction of diseases of cultivated plants which do not now occur in the Archipelago. The importance of the subject is well illustrated by the coffee blight, caused by a specific fungus, *Hemileia vastatrix,* which was introduced into the Philippines about twenty-five years ago, and which has practically killed the coffee industry in the Philippines. Now coffee in great quantities is imported; before the advent of the coffee blight great quantities of coffee were exported.

Examination of diseased plants, determination of the causes of the disease, and indicating methods of treatment and control are a part of the routine work of this office, and such work is done gratis for other bureaus, especially the Bureau of Agriculture, and for individuals.

38. *Vegetable physiology.*—Extensive investigations are in progress on different phases of this broad and important subject, especially in connection with the influence of external factors, such as light, heat, humidity, rainfall, and wind, on the vegetation. The conclusion of the work will give us an immense amount of valuable data bearing on economic problems in connection with forestry and agriculture.

39. *Historical.*—A great amount of data has been gathered on the historical side of Philippine botany, on botanists who have worked on the Philippine flora both locally and in Europe, on regions explored, on where the collections are preserved, on botanical gardens, etc. Some of the data have been published in an article on the Pineda Monument—which has been entirely destroyed—and the probable location of the first botanical garden.

40. *Forest reserves.*—In one forest reserve, established some years ago, a very extensive study of the constituents of the forests, of different types of vegetative "formations," etc. has been completed. On another recently established reserve, that of Mount Maquiling, a similar study is being carried on, but on a scale even more intensive than in the first case. The foresters are enabled to determine not only the constituent species, but also the associations in which the species grow and factors limiting the range of certain species. In case replanting were necessary, the species to be selected would be at once evident. The study of the Maquiling reserve will be especially helpful on account of the fact that the College of Agriculture, where a course

in forestry is given, is located near the reserve, and students do most of their field work in the reserve. The botanical results will be available to students both of forestry and of agriculture.

41. *Forestry.*—The matter of the correct classification of commercial timber trees is one of great importance to the forester, especially in the Philippines where we have such an immense number of trees—about 2,500 species. Only a small percentage of these, however, is of commercial value. With the correct identification of the species, as made by this Bureau, the foresters have been able to refer the names of the various timber trees to a standard nomenclature and thus have been able to reduce the infinite number of native names as synonyms to selected standard names and our scientists have been able especially to correlate the commercial Philippine timbers with similar or allied forms in other parts of the Indo-Malayan region.

42. *Horticulture.*—In order to help stimulate local interest among Government officials and private citizens in the matter of the selection, propagation, and care of ornamental plants and shade trees, considerable attention has been given to this phase of horticulture, two editions of a descriptive catalogue of the plants cultivated in the city nursery at the Cementerio del Norte have been prepared, and an article on selected shade trees and their care prepared and published in the Quarterly Bulletin of the Bureau of Public Works. Through exchanges arranged by the Bureau of Science, seeds of numerous ornamental palms and other plants have been received from foreign countries for propagation here.

43. *Mango bud-blight.*—In the Philippines there is a mango bud-blight which attacks the mango flowers at about the time they are opening, grows over them, and causes them to become abortive and fail to set fruit. The attention of growers has repeatedly been called to the fact that, if they would take the trouble to spray the trees with a weak Bordeaux mixture at the time of flowering, a good crop could be obtained.

44. *Hats and hat-making materials.*—Investigations have been made and published on the different types of hats manufactured, their characteristics, the materials of which they are made, how the materials are prepared, and where they are secured. The published article also takes into consideration the grades of hats and the centers of the hat-making industry in the Philippines. This subject is one of considerable commercial importance, for the manufacture and export of hats from the Philippines is a comparatively large industry.

45. *Medicinal plants.*—A very large number of plants are used

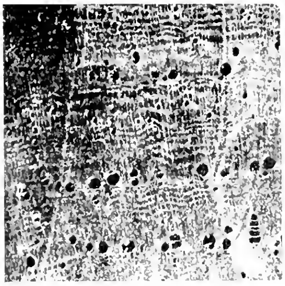

Fig. 1. Narra.

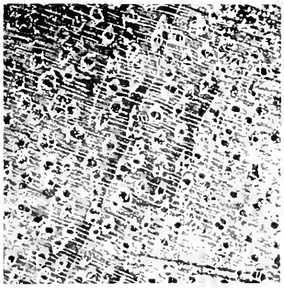

Fig. 2. Ipil.

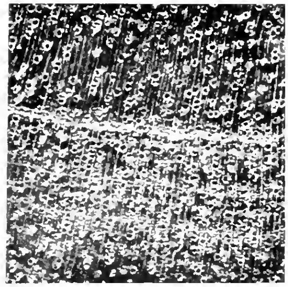

Fig. 3. Guijo.

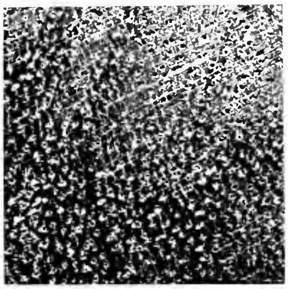

Fig. 4. Macaasin.

Fig. 5. Mancano.

Fig. 6. Station for investigations on plant physiology, Mount Maquiling. Shelter for self-recording hygrometer.

PLATE XXXII.

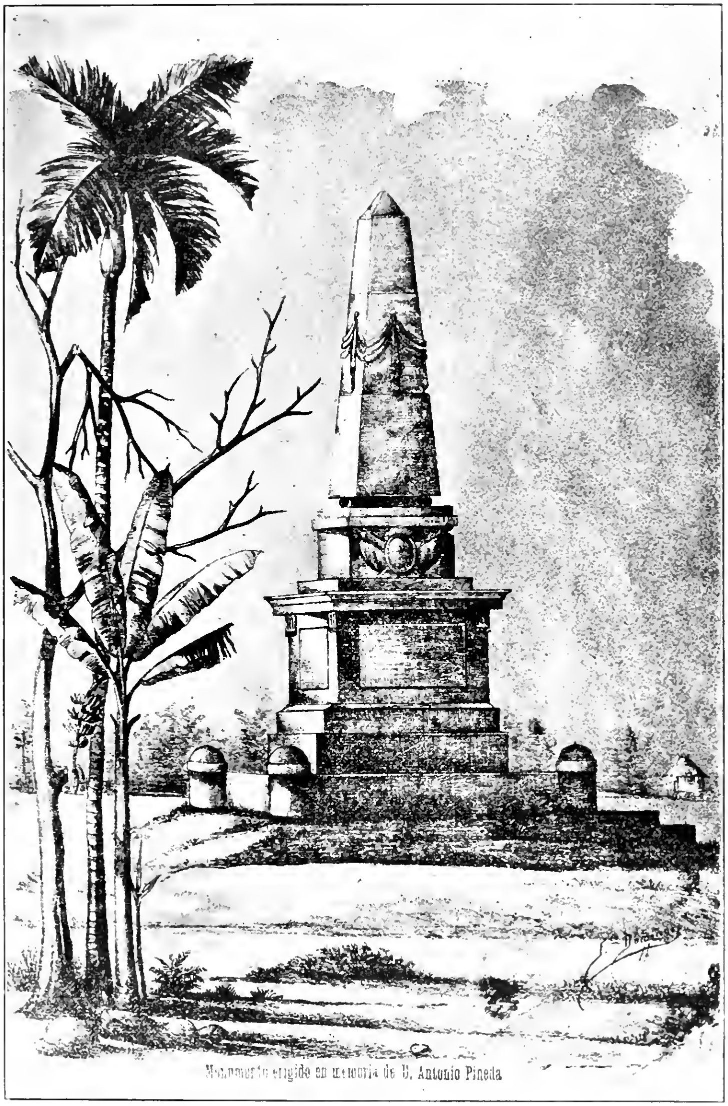

PLATE XXXIII. THE PINEDA MONUMENT.

PLATE XXXIV. DRIVEWAY AT CEMENTERIO DEL NORTE, MANILA.

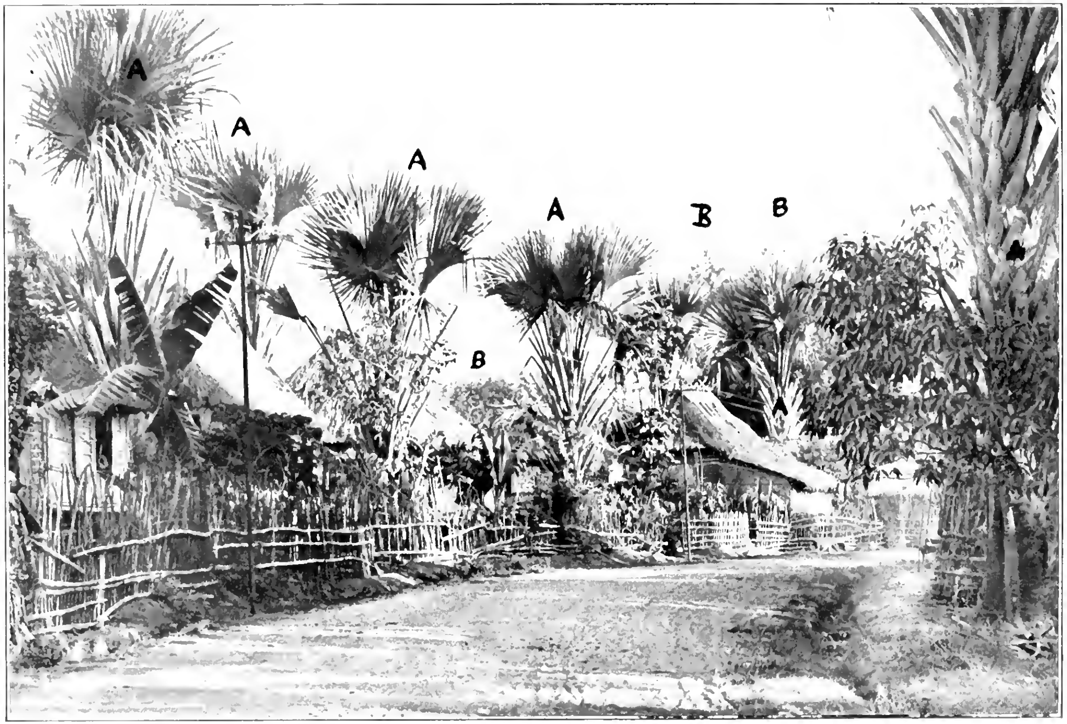

PLATE XXXV. VIEW IN PANGASINAN PROVINCE, SHOWING BURI PALM (A) AND BAMBOO (B).

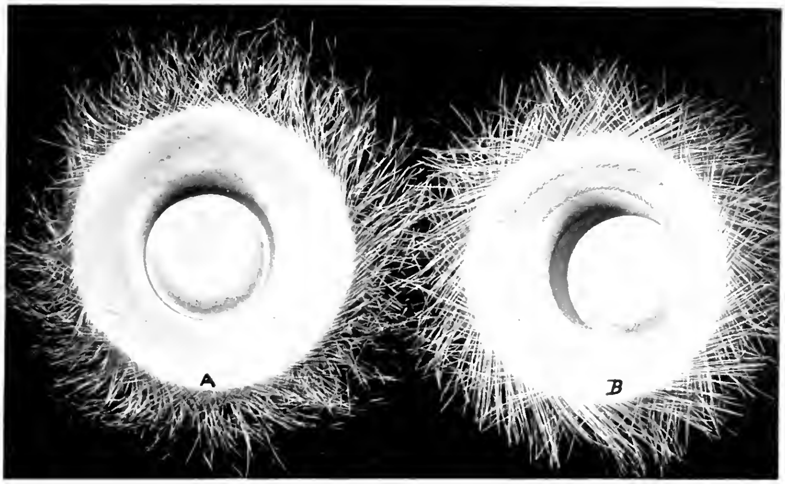

Fig. 1. Outer and inner halves of one Calasiao hat.

Fig. 2. Completed buri-midrib (Calasiao) hat.

PLATE XXXVI.

PLATE XXXVII. FRUIT OF ST. IGNATIUS BEAN (STRYCHNOS IGNATII BERG.).

A strychnine-producing plant known only from the Philippine Islands.

by the natives in the treatment of diseases. Some of these plants have important properties that are thoroughly understood, and a few are recognized as the sources of various medicines in the standard pharmacopœia. A still larger number remain to be investigated, in order to prove or disprove their reputed medicinal qualities. The active constituents of many medicinal plants growing in the Islands have been isolated and identified. *Dita, Datura, sibucao, macabuhay, bonduc,* purging oils, and the fish and arrow poisons may be mentioned as illustrating our work along this line.

46. *Tans and dyes.*—The assessed value of tanning materials imported into the United States in 1910 exceeded $6,500,000, and European tanners each year are becoming more dependent upon imported materials. Data collected by the Bureau of Science show that Philippine mangrove barks of the better species contain about 30 per cent of tannin and indicate that a net profit of from ₱50 to ₱60 per ton can be made on tanning materials derived from the mangrove swamps of the Philippine Islands. There are areas of workable swamps in the Islands capable of producing 1,500 metric tons of extract yearly, having a value of ₱210,000. The exploitation of these swamps would involve a firewood and piling industry of about an equal magnitude.

Many local species of plants yield dyes. These vegetable dyes are of comparatively little importance commercially, as most of them have been replaced by aniline dyes.

47. *Paper pulp.*—This Bureau has carried on for several years investigations of bamboo, cogon, abacá or hemp, and various palm fibers as materials suitable for the commercial manufacture of paper. The data collected have been accurately interpreted with due regard to the local conditions bearing upon the subject, and show that an industry of great potential economic value can be developed. Careful surveys of some of the bamboo fields available have been made. Sufficient data with regard to the cost of the raw material, the quantity of bamboo available, the cost of manufacture of the pulp, etc., are given to show that the bamboo soda pulp can be developed into a profitable export trade in direct competition with chemical wood pulp at present quotations. Other countries have appreciated the work done by the Bureau of Science, and our work will undoubtedly be the means of starting the paper industry in the Philippines at some future time.

48. *Coconuts.*—The solution of the many problems relating to coconuts, copra, and coconut oil is of vital importance to the progress and success of this industry. The production and value

of the Philippine coconut will continue to increase, and intelligent control must be based upon careful scientific investigation. The results of our work on the subject have been published from time to time as various phases were completed. These have included the water relation of the coconut palm, the relation of the coconut and the production of coconut oil and that between the location of the palm and oil content of the nut, the hydrolysis and subsequent destruction of fat, methods of drying, insect pests and preventive measures, the influence of sprouting on the copra and oil, methods of analysis, effects of feeding copra cake as cattle food, the purification of coconut oil and its detection as an adulterant in other oils, and the deterioration of copra during storage. To a large extent it is possible to determine beforehand from a simple examination of the vegetation in connection with the recorded distribution of rainfall, whether or not coconuts will thrive in a particular locality. Experiments have proved that the coconut tree can be kept practically free from the attacks of its only serious pests, the *uang* (*Oryctes rhinoceros*) and the weevil (*Rhynchophorus ferrugineus*), by keeping the coconut groves clear of dead and decaying trees and rubbish and by allowing the dead leaf-petioles to fall naturally. The work is being continued, and results will be published as they become available.

49. *Sugar.*—A press bulletin has been issued which shows the financial loss occasioned by the harvesting of unripe sugar cane and which demonstrates that an actual loss can be converted into a material gain if proper instructions are followed. Tests of sugar cane made in India with regard to the loss in value of the crop due to the disease "red-rot" show a diminution of 45 per cent in available sugar. This Bureau has demonstrated that red-rot is more or less prevalent in the Philippines, and the attention of planters has been called to the fact that they should take advantage of the data and be careful to select seed cane and weed out that which has become diseased. Sugar cane is singularly free from pests except when a region is temporarily infested by locusts. In certain regions where intensive culture has been started in recent years, the leaf hopper has proved very destructive at times, but suggestions from this Bureau as to cleaner methods of harvesting, together with allowing certain parasites of these pests to develop before the cane is cut, have undoubtedly done much to lessen the destruction of sugar cane. Other pests which may develop in importance are being studied. Reliable information concerning the conditions of agricultural

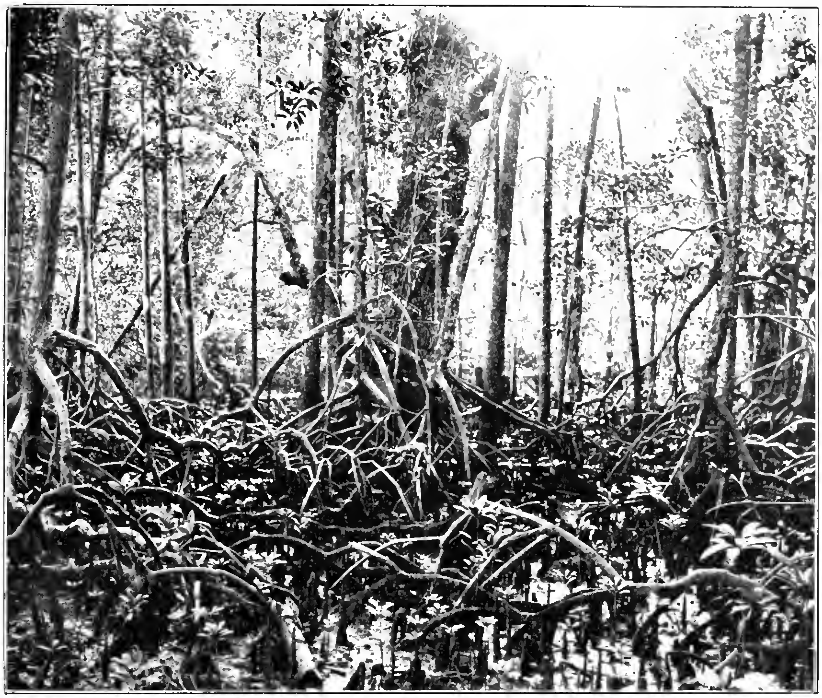

Fig. 1. Interior view of a mangrove swamp.

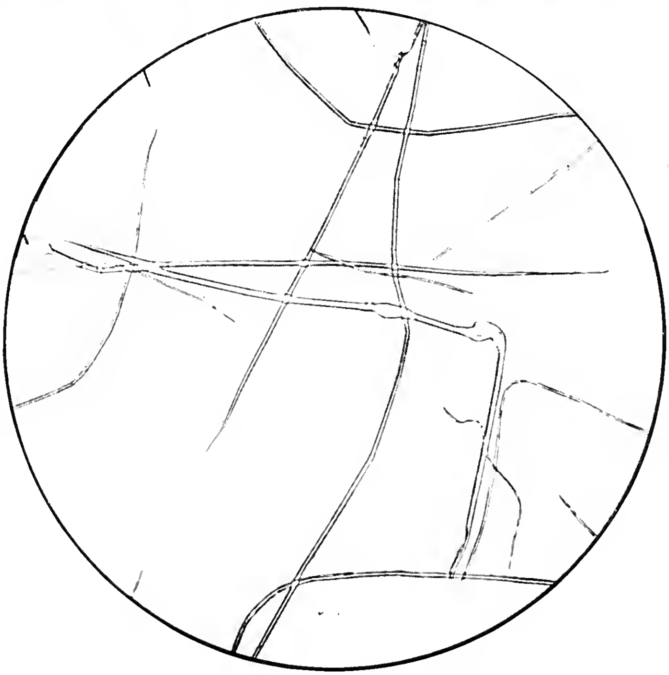

Fig. 2. Dwarf bamboo (Bambusa blumeana Schultes f.). Fibers seen longitudinally.

PLATE XXXVIII.

PLATE XL. SUN DRYING COPRA, SHOWING COCONUTS ON TRAYS, READY TO BE PUSHED UNDER THE SHELTER.

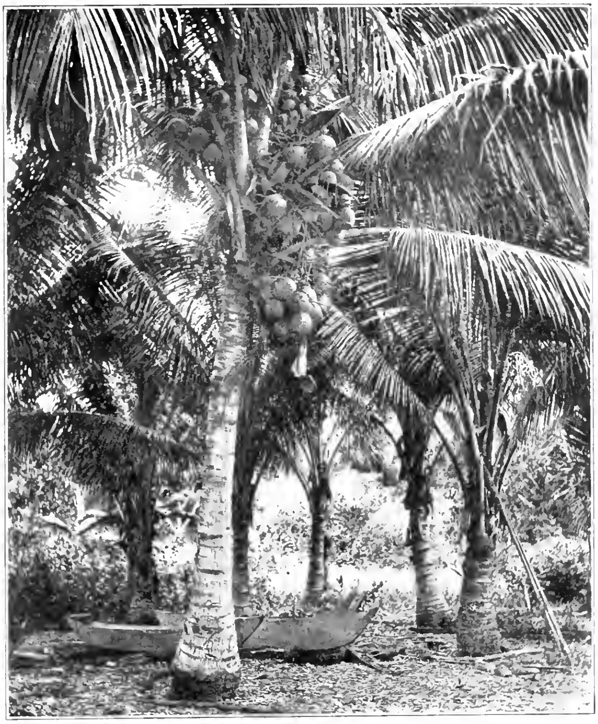

Fig. 1. Coconuts, Mindanao.

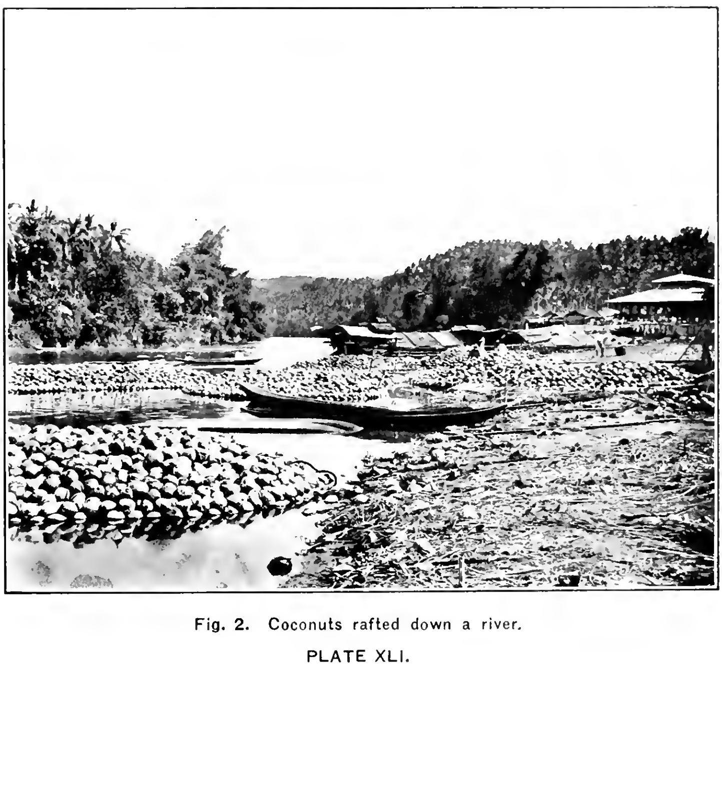

Fig. 2. Coconuts rafted down a river.

PLATE XLI.

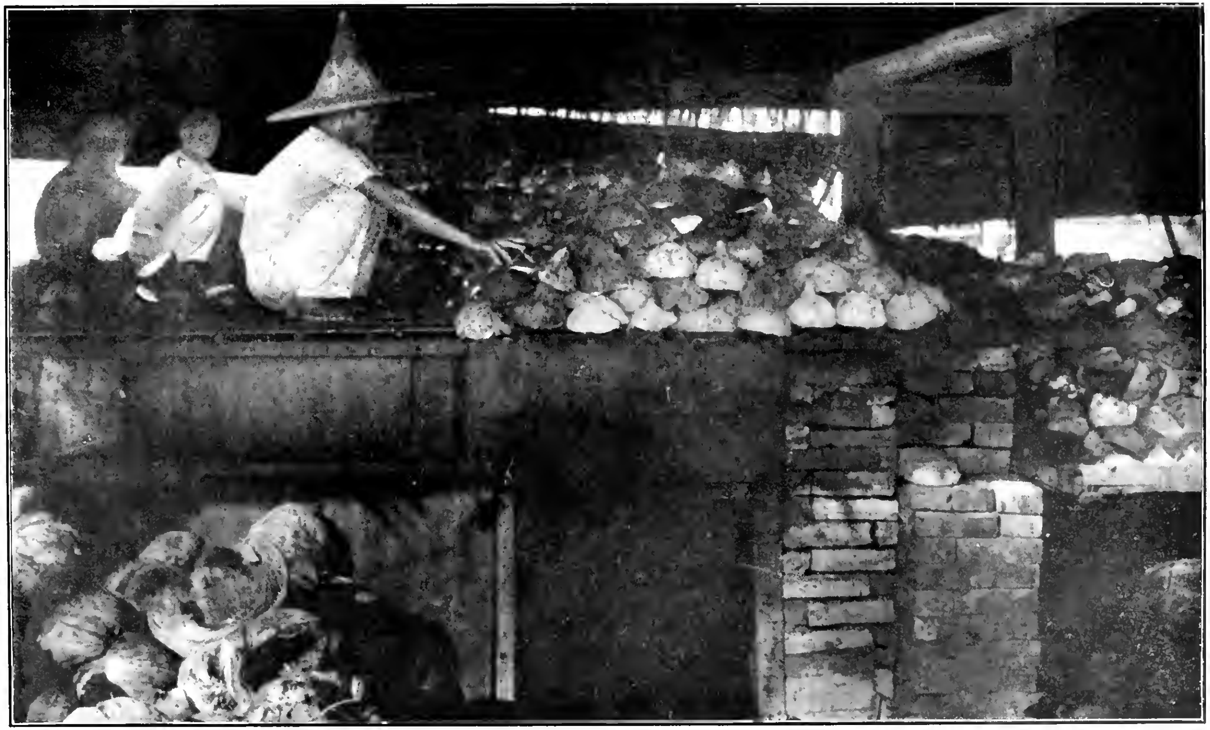

PLATE XLII. KILN DRYING; THE HALVES OF THE COCONUTS ARE PLACED OVER THE GRILL FOR THE PRELIMINARY DRYING.

Fig. 1. Cane crusher near Agoo, La Union Province.

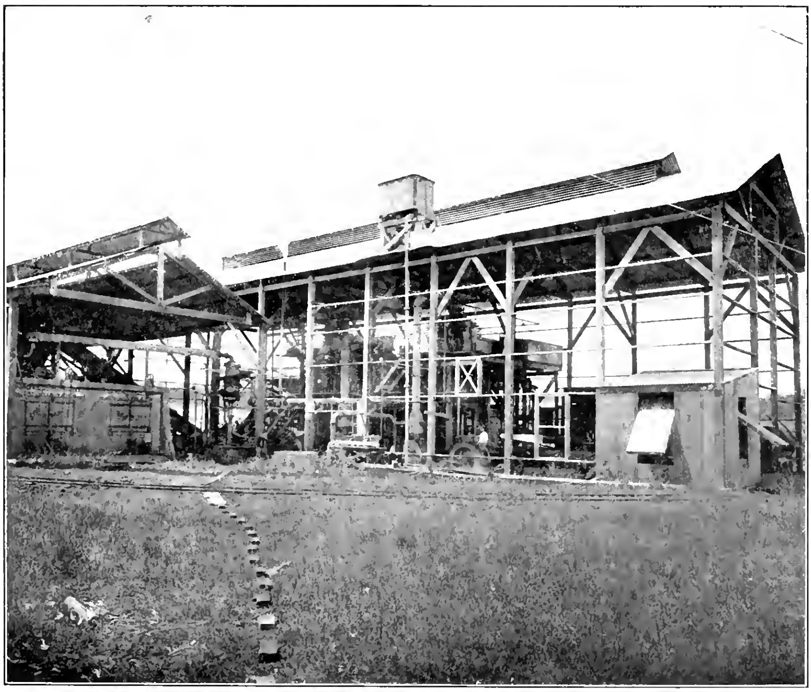

Fig. 2. A modern sugar mill.

PLATE XLIII.

Fig. 1. Collecting nipa sap.

Fig. 2. Nipa palms in fruit.

PLATE XLIV.

practice in cane growing and sugar making, prevailing in various parts of the Philippine Islands, has been collected. Part of this has been published in a monograph of the Bureau of Science, entitled The Sugar Industry in the Island of Negros, by H. S. Walker.

50. *Sugar from palm saps.*—It has long been known that a large number of palm trees secrete a sap rich in sugar, and the natives of various countries have taken advantage of this fact to supply themselves with limited amounts of this commodity. No exportation on a commercial scale has been attempted for the reason that it promised no financial returns.

We have found in the nipa palm, which grows extensively in a number of places in the Philippine Islands, covering large swamp areas which would otherwise be waste, a source of sugar which has been proved to be very attractive from the standpoint of investment. The sap, as it flows from the palm, has approximately the composition of the sap of the sugar cane, and we have developed methods for its collection and preservation during transportation to the refinery. The difficulties encountered for the establishment of the business upon a large commercial scale have been entirely overcome through our investigations. The results of this work will be published in Section A of The Philippine Journal of Science of this year.

This marks the establishment of an industry new to the world, and one which will be unique to the Philippine Islands and give employment to a large number of Filipinos.

51. *Alcohol.*—Suggestions have been made for increasing the yield of alcohol by improving the existing methods of manufacture. In extreme cases the present available loss is very high. [The Philippine Journal of Science, Section A (1911), 6, 136–206.]

52. *Essential oils and terpenes.*—The most important essential oils and terpenes have been studied, and their commercial value discussed. This rather comprehensive investigation has shown that excellent turpentine and colophony (practically identical with those from American pines) may be produced from the plentiful pines of Benguet. The various resins, such as elemi, balao, apitong, and copal, have been investigated both from the scientific standpoint of their chemical composition and from the practical consideration of their use in the manufacture of varnish etc. The essential oils responsible for the fragrance of many plants and flowers have also received considerable attention. Among these may be mentioned ylang-ylang, champaca,

orange, lemon grass, vetiver, cinnamon, and ginger. Several of these have commercial application in the perfume industry and others in the manufacture of nonalcoholic beverages and fruit flavors. Other oils investigated during the past few years comprise lumbang or candlenut, kapok, cashew, castor, cotton seed, and physic nut. These represent a type derived from oil-bearing seeds, and have a commercial importance of considerable magnitude.

53. *Philippine foodstuffs.*—The many unique and characteristic foodstuffs used by the native population have received attention, as well as the citrus and other fruits. The nutritive value of these products is now known, and is available for studying dietary questions of great practical importance. All varieties of canned milks entering the Islands, as well as fresh cows', goats', and carabaos' milks, have been included in this study. The importance of this question in controlling and reducing the high infant mortality can hardly be overestimated. All data collected regarding food products are, moreover, of utility in preparing standards for, and in enforcing, the Pure Food and Drugs Act to protect the health and welfare of the public.

54. *Opium.*—The prevalence of opium and other drugs used contrary to law in many sections more than justifies the researches carried on regarding their detection and characteristics.

55. *Water.*—This Bureau has made over 1,100 chemical and bacteriological examinations of waters from various sources of local supply. We have made thorough examinations of waters from springs, dug wells, drilled wells, rivers, reservoirs, cisterns, etc.; and have passed judgment upon their state of pollution or potability, their suitability for domestic and industrial use, or their medicinal value. The question of health in the tropics is largely a question of proper sanitation, and its principal adjunct is a good, potable, nonpolluted water supply. The purity of the water supply is also an important direct financial consideration, and, although few realize the great difference between the commercial values of hard and soft water, large savings have been effected by the substitution of a soft for a hard water supply even at the cost of preliminary treatment.

56. *Soils.*—The chemical and physical properties of Philippine soils, and also some of the conditions which influence them, such as, rainfall, humidity, the maximum and minimum air temperatures, the temperature under the surface, the amount of light and sunshine, winds and the evaporation of the soil moisture, exposure, and altitude, have been taken into account. All these

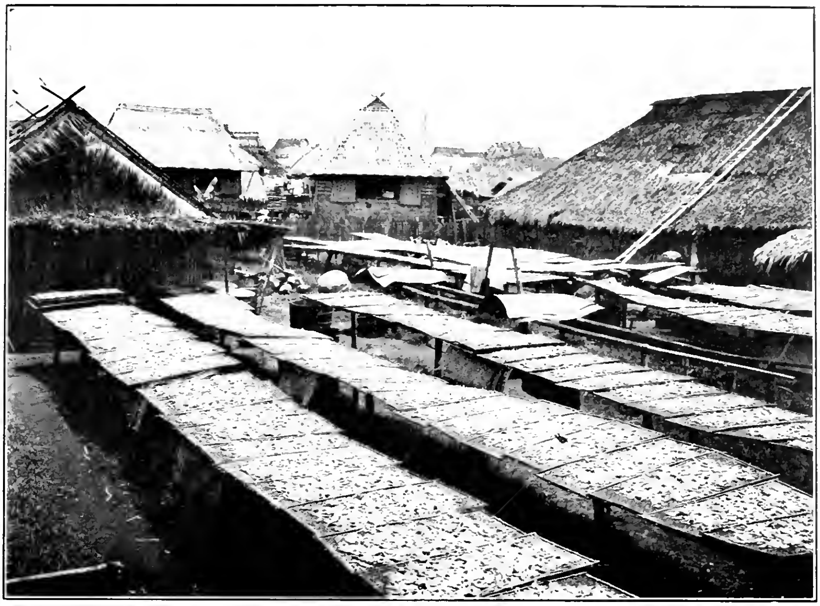

Fig. 1. Fish drying in the sun.

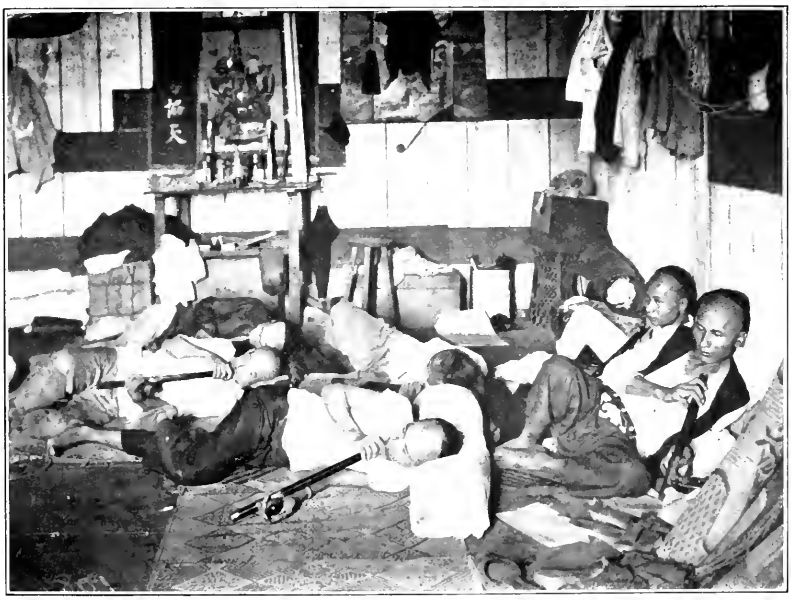

Fig. 2. Opium den.

PLATE XLV.

factors influence the soil, and a most intelligent and thorough understanding and systematization of them is necessary to obtain the best results, for at a given time any one of these may become a controlling factor in the production of a crop. Because of the more or less crude methods of cultivation in use throughout the Archipelago, it has not always been easy to determine whether the chemical or the cultural elements are the limiting factors.

Hundreds of soils from the more important agricultural regions of Luzon and other islands have been analyzed, and show that different sections vary in their chemical and physical compositions. Eventually, these analyses will form a basis for more extended work on methods of fertilization and production of special crops adapted to the different localities. This information in conjunction with data concerning the crops grown may give information regarding the needs of the soil and the kind of crops adapted to a particular region.

This Bureau has been able to supply information concerning the potential fertility of the soil, ease of plowing, drainage, and consequent effect upon bacterial development. We have been able to predict the soil constituents that would be exhausted in the course of crop production and to indicate the proper fertilizers as well as the abundant elements of plant food that would not need to be supplied by fertilization.

In the absence of more authentic data, it is possible to judge by an examination of the vegetation whether important crops, such as coconuts, abacá, maguey, rubber, and tobacco, will thrive in a particular locality. Where certain species of plants are dominant, there is a prolonged dry season; where the rainfall is continuous, more vigorous species crowd them out. Full data are not yet available on the exact types of vegetation indicating the probable success or failure of all of these crops, but in general the presence or absence of certain native species in a given region well indicates what cultivated plants may be expected to thrive and what in all probability will not thrive. From a commercial standpoint, the importance of this is very great, for no individual should risk the loss of money in the establishment of plantations in regions where it is practically certain that his particular crop will not thrive.

57. *Fertilizers.*—In recent years the exploitation of the guanos of the Islands has been attempted, and the Bureau has been called upon to analyze and give necessary information concerning their possible commercial value. Data and analyses concerning a considerable number of guanos have been published in order to

indicate what may be expected of the deposits in the different parts of the Archipelago.

At times the Bureau has been called upon to determine the utility of certain substances as fertilizers, their method of application, and to adjust conflicts of analyses between buyer and seller.

58. *Salt.*—The Bureau of Science has taken up the study of the salt industry and resources of the Philippine Islands. Salt is produced by the use of solar heat or, in limited quantities, by the use of direct artificial heat. The methods employed for the preparation of salt from sea water by the use of solar heat are very crude, and the method now most commonly employed is probably the original one used in these Islands. In recent years the Chinese have introduced a somewhat improved method.

The people of Mountain Province produce a small amount of a poor grade of salt by evaporating water from carbonated springs. At Mainit, Bontoc; Tukukan, Ahin, and Bungabungna, Ifugao; and Salinas, Nueva Vizcaya, the supplies of brine vary in quantity and strength. The resources of these springs should be developed in order adequately to supply Mountain Province with salt at a reasonable price.

In round numbers 20,000,000 kilograms of crude salt are produced annually. Scientific study of this industry will indicate how to increase the output of each individual employed and to improve the quality of the product.

59. *Sunlight.*—The study of sunlight and its effect upon chemicals and animals has been carried on for a period of over five years. The work so far has shown that the injury attributed to the actinic rays of the sun is greatly exaggerated, and that if these so-called actinic rays are injurious in the tropics they are equally so on clear days in the other portions of the world. Some effects of sunlight upon individuals whose skins do not furnish the proper protection due to lack of pigmentation have shown that certain reactions seriously affecting the health of the individual may occur. Comparisons of sunlight intensities determined at our suggestion by means of a chemical photometer at various places, including Manila, Baguio, Kuala Lumpur, Honolulu, Khartoum, Washington, Munich, and several places in Australia have been made. These show that on clear days at many of the places investigated the rate of reaction is practically the same; therefore, the normal sunlight intensities throughout the various regions of the earth are practically identical.

It has been found that sunlight produces effects on a large

Fig. 1. A leaching vat built on the ground, but high enough so that the mud may be removed by gravity after the leaching is completed.

Fig. 2. A more developed and more progressive type of leach. A kind of cultivator used in loosening the soil is also shown.

PLATE XLVI.

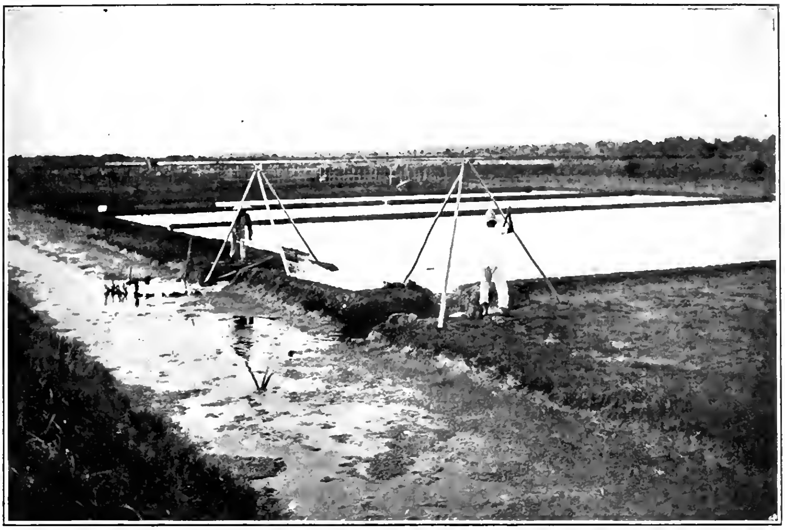

Fig. 1. Showing the apparatus for transferring brine from evaporating reservoirs to crystallizing vats which are on a higher level.

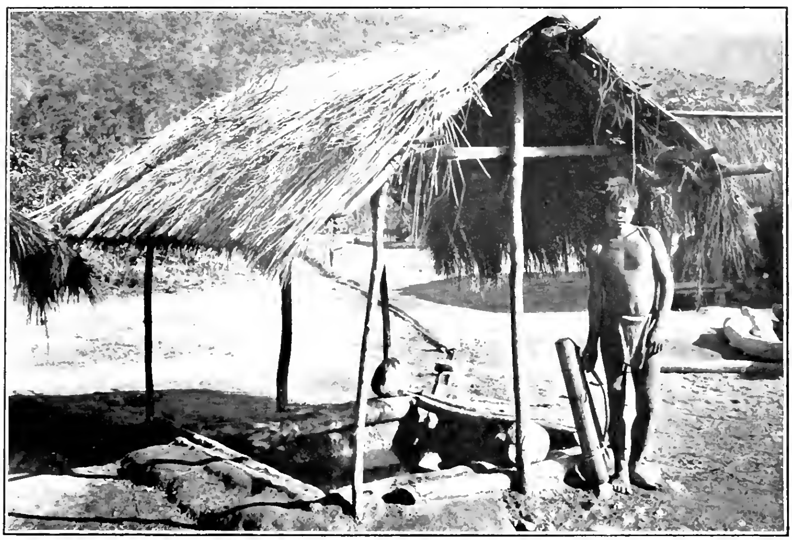

Fig. 2. The lower end of a bamboo trough from the Salinas salt springs, showing the well from which the brine is carried to the evaporating pans.

PLATE XLVII.

number of pure chemicals heretofore unsuspected. Many new chemical reactions in sunlight and the mechanism concerning a number of old ones have been discovered.

60. *Standardization and testing of supplies.*—This Bureau has long maintained a laboratory for the purpose of testing and analyzing the various products purchased under contract for Government supplies. We have tested numerous samples of bituminous and metallic roofing materials for the United States Army; and khaki, shirts, puttees, rain capes, blankets, leather goods, paints, iron and steel, rope, wire, twine, paper, oils, canvas, Babbitt metals, alloys, tiles, bricks, concrete, fabrics, etc. for the local Government. The scope and work of this department have shown a decided increase during recent years, owing largely to a growing realization of the value and necessity of purchasing materials on a basis of quality or, at least, according to specified requirements which will guarantee satisfactory service. Usually, when the testing of a certain class of material is first instituted, the samples submitted give very unsatisfactory results, and immediately the manufacturers protest vigorously and complain that the tests are impractical or the testing improperly done and unfair. However, it is a matter of record that when specifications are rigidly enforced, most of the materials subsequently submitted are so uniformly excellent that it is difficult to decide in favor of any particular one. The records also show that the improvement in quality is usually obtained without an increase in cost.

61. *Asphalts, bitumen, tars, and oils for road materials.*—This Bureau in conjunction with the Bureau of Public Works has given considerable attention to the physical and chemical properties of bituminous road materials. Careful inspection and examination both of the materials employed and their durability under different local conditions of climate and service will give information of much value and will determine their suitability for use according to various methods of application and construction.

62. *Portland cement.*—For the past five years our investigators have carried on painstaking observations and careful experimental work to study the technology of manufacturing, testing, and use of Portland cement. Those characteristics of Portland cement, regarding which there existed the greatest amount of misconception and diversity of opinion, were studied in an endeavor to assist in the universal effort to formulate cement specifications so drawn as to guarantee the manufacture and use of Portland cement of the quality sought for, and the work of

the investigators has given us a more reliable product in the Philippine Islands. The importance in relation to safe construction and to the saving of money to be effected by carrying on such work is very great. During one fiscal year, 71,778,675 kilograms, or a value of ₱1,524,600, of Portland cement were imported into the Philippine Islands. At a low estimate the total cost of the corresponding concrete was six times the cost of the cement, or ₱9,147,600. A gain or loss of 1 per cent in the efficiency of this material in durability and strength represents a money value of ₱91,476.

Our investigation proved that the efficiency of Portland cement is obtained at a corresponding expense to the manufacturer, and cements should be purchased on a basis of quality rather than upon a mere consideration of quantity, and the information gained from this research work enabled us to suggest "a bonus system for the purchase of Portland cement," the enforcement of which, it is believed, would secure the best cement at a reasonable cost and eliminate the necessity of occasionally rejecting cements as has heretofore occurred.

Our investigations with regard to the manufacture of Portland cement from local raw materials have proved that there is an abundance of calcareous and siliceous material in certain desirable localities which are well suited for the manufacture of Portland cement on a commercial scale. As there is no cement plant in the Philippine Islands, all of the Portland cement used in this country has been imported, and the high cost for shipping and transportation makes our concrete construction expensive. The average cost of Portland cement in the United States is about ₱2 per barrel, but the local Government on large contracts now pays from ₱5.50 to ₱6.50 per barrel.

63. *Concrete.*—Careful, systematic inspection of the sand, gravel, and stone, as well as of the cement used in all concrete construction, is necessary to secure satisfactory permanent results, and reliable and economic practice in concrete construction cannot be assured until the quality and concrete efficiency of the available aggregates—sands, gravels, and crushed stones—have been thoroughly investigated. The Bureau of Science has shown that many of the aggregates which have been used for this purpose are of poor quality, and that adequate consideration is not given to the fact that the nature of the aggregate is fully as important as the quality of the cement. Our investigations indicate the necessity of adopting standard methods for testing concrete and aggregates and a thorough and systematic study

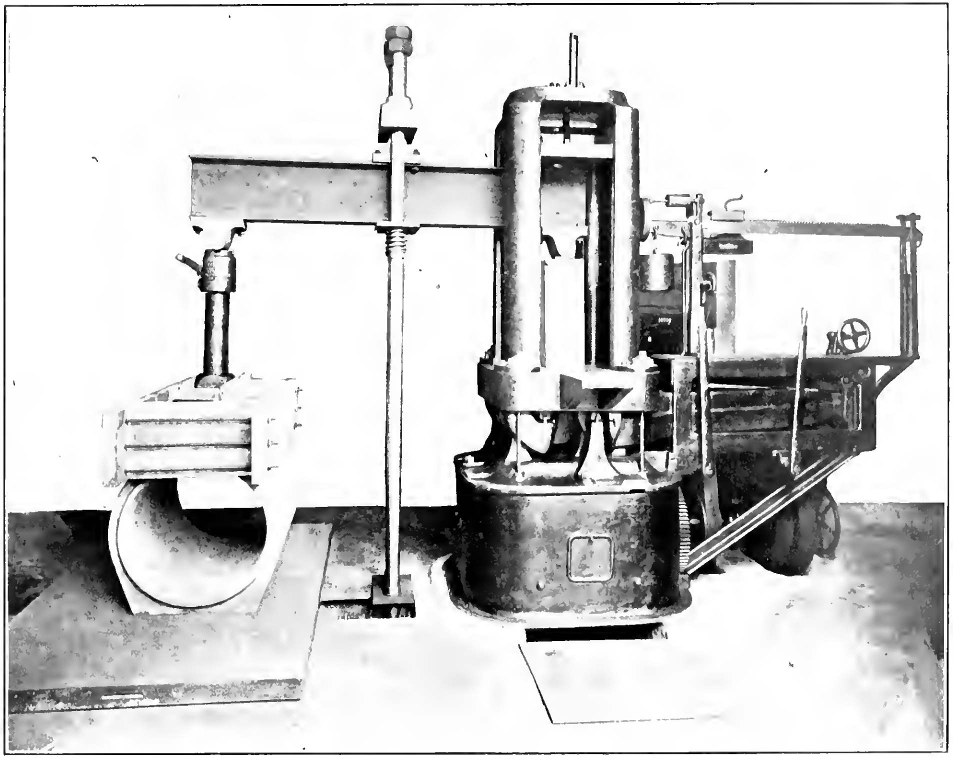

PLATE XLVIII. TESTING MACHINE BREAKING CONCRETE PIPES.

PLATE XLIX. PORTLAND CEMENT MANUFACTURED FROM PHILIPPINE RAW MATERIALS, SHOWING PERFECT SOUNDNESS OF FOUR DIFFERENT MIXTURES FROM ONE DISTRICT.

PLATE L. CONE FROM CRUSHED CUBE OF CONCRETE FROM ABATAN RIVER, CORTES, BOHOL, SHOWING EFFECT OF USING GRAVEL COVERED WITH GREEN ALGÆ.

of the most promising Philippine materials which are available for concrete work in different localities.

64. *Nonmetallic deposits.*—Field investigations have revealed the existence of materials suitable for various purposes and of economic importance; for example, asbestos and sulphur deposits; limestones; sand; volcanic tuff and ash; clays and shales suitable for the manufacture of Portland cement, hydraulic cement, sand-lime brick, vitrified brick, refractory ware, and pottery; and stone suitable for lithographic purposes. In the calendar year 1912 the importations of china-, earthern-, and stoneware alone amounted to ₱391,852, of which 50 per cent could easily be produced in the Philippines. The importations of Portland cement for the same period amounted to ₱1,136,456.

65. *Sand-lime brick and artificial sandstones.*—A study of available local materials and conditions showed that the latter in the Philippines are very favorable for the manufacture of brick and artificial stone from sand and lime; that the best location for the first plant is probably in the vicinity of Manila near Pasig River at Guadalupe; that strong, dense, durable, impermeable, and practically fireproof sandstone could be made by the steaming process from sands from Manila beach, Pasig River, and Orani River, and from Tarlac volcanic tuff, quarry débris from Sisiman (andesite), or Talim (basalt) rock; that the beach sand was the most economic material; that beautiful polished "marbles" could be manufactured from the quarry débris; that the cost of manufacturing and selling 9-inch bricks of the best quality would not exceed ₱13 per thousand; and that the profit of a plant could be increased by extending its operation to include the manufacture of lime, hollow building blocks, tiles, slabs, marbles, ornamental stones, etc. We are now investigating the available raw materials in the vicinity of Cebu, and hope eventually to include the vicinities of Iloilo, Zamboanga, and Jolo.

66. *Vitrified brick.*—We have made pressed and vitrified brick from Philippine materials which have given very promising results. The local manufacture of this product would be of great financial importance.

67. *Quarries.*—The city of Manila uses about 50,000 cubic meters of crushed stone each year for surfacing streets. A recent investigation of Laguna stone-quarries by a special committee which included a geologist of this Bureau has shown that a much better rock could be secured and with an actual annual saving of at least ₱21,000 to the city of Manila, besides a considerable saving in maintenance.

The Bureau of Science is equipped with apparatus for determining the relative value of various kinds of stone for macadamizing streets by submitting them to an abrasion test and determining their cementation value, toughness, absorption, hardness, specific gravity, and strength. Over 800 samples of stone from different parts of the Islands have been tested.

68. *Coal.*—The Bureau of Science has made geologic reconnaissances of all the better known coal localities, as well as a study of their physical and chemical characteristics. The data secured relate to the topography, transportation, labor, timber, age and character of the formations, physical properties, chemical analyses, calorimetric value, coking qualities, oxidation, deterioration, slacking, spontaneous combustion, storage, utilization, the comparison with other coals on the market, etc. Data concerning all features connected with coal from its discovery and development to its most economical utilization, which will assist commercial concerns, have been given. Geologic studies have revealed the position, number, and relations of various seams found in the scattered outcrops as well as of deposits not outcropping on the surface, by the application of paleontologic principles. The existence and extent of faulting and other disturbing features have been studied. Chemical studies show that certain coals which are subject to air slacking and spontaneous combustion can be stored in a manner such that their physical integrity is maintained, avoiding great loses and possible conflagration.

69. *Producer-gas plant.*—Investigations show that certain Philippine coals are not wholly satisfactory, *a priori,* as steaming coals. This Bureau now has a 67-horsepower producer-gas unit with the corresponding engine and electric generator direct coupled. Coal from East Batan Island has been used exclusively for this plant, and experiments have demonstrated its excellent adaptability to this purpose. Philippine coal burned in the producer unit is 50 per cent more efficient in the production of electric power than the Japanese coal burned under a steam boiler. It is probable that the poorest coals employed in a producer-gas plant may become as valuable as the best grades of coal used in a steam plant or, perhaps, even supersede the steam plant altogether for stationary work.

70. *Petroleum.*—Samples of petroleum have been collected from Philippine formations. The geology has been worked out in one field in sufficient detail to enable us to see that the structure is favorable for the accumulation of commercial quantities of oil. Various authentic samples have been studied, and

Fig. 1. Finishing a "tenaja."

Fig. 2. Beating pots into final shape.

Fig. 3. Native pottery market, Ilocos Sur.

PLATE LI. PHILIPPINE POTTERY.

Fig. 1. Pile of pottery, showing method of burning.

Fig. 2. Glazed ware (made by first-year students).

PLATE LII.

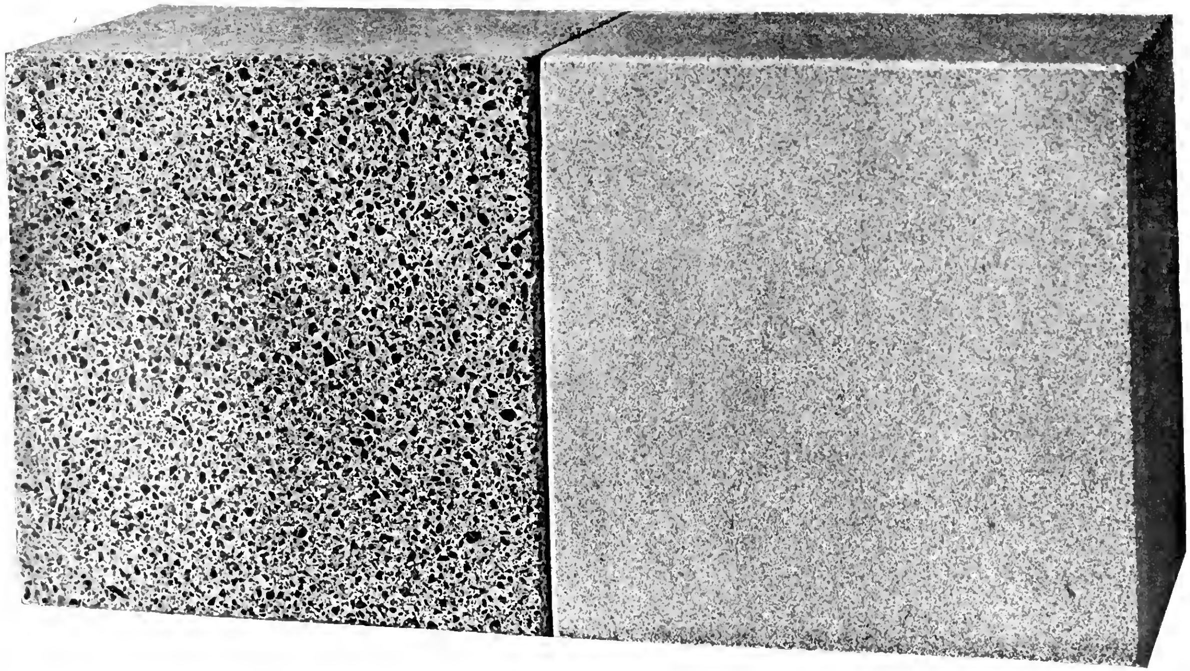

Fig. 1. Talim basalt quarry débris, brick mixture.

Fig. 2. Maytubig beach sand, brick mixture.

PLATE LIII. SAND-LIME BRICK AND ARTIFICIAL SANDSTONE.

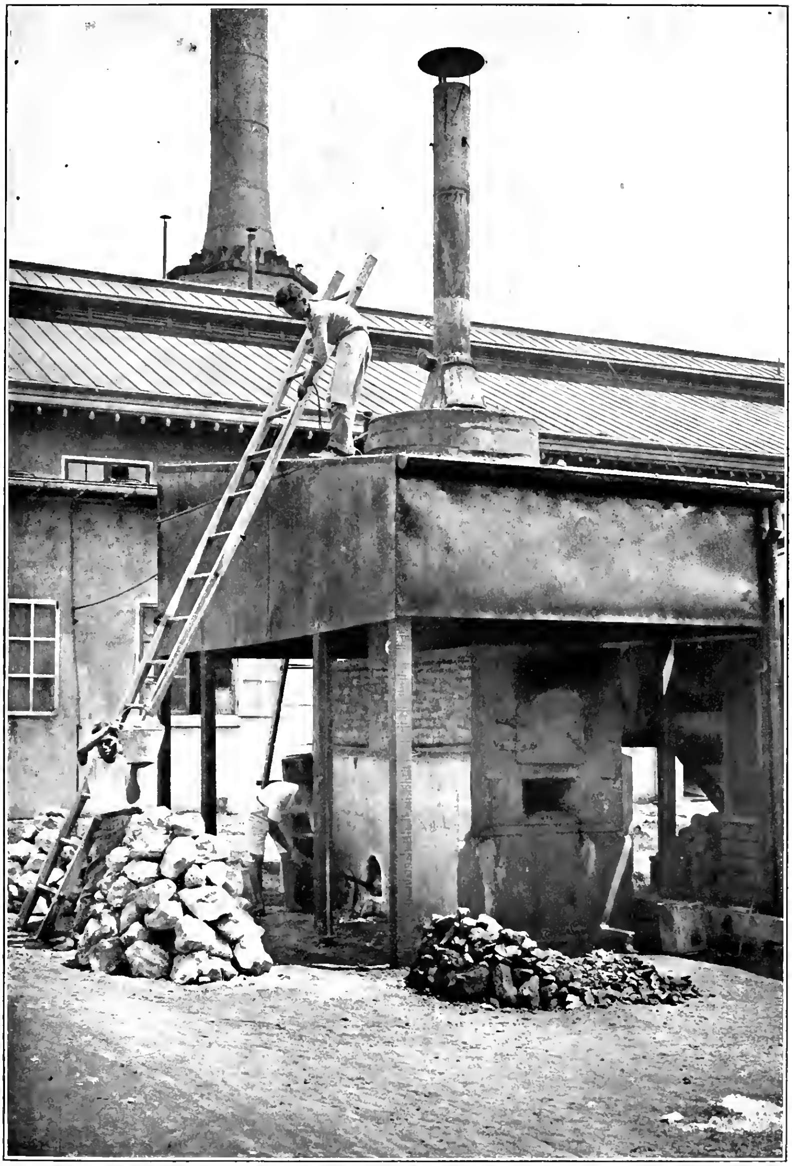

PLATE LIV. LIME KILN.

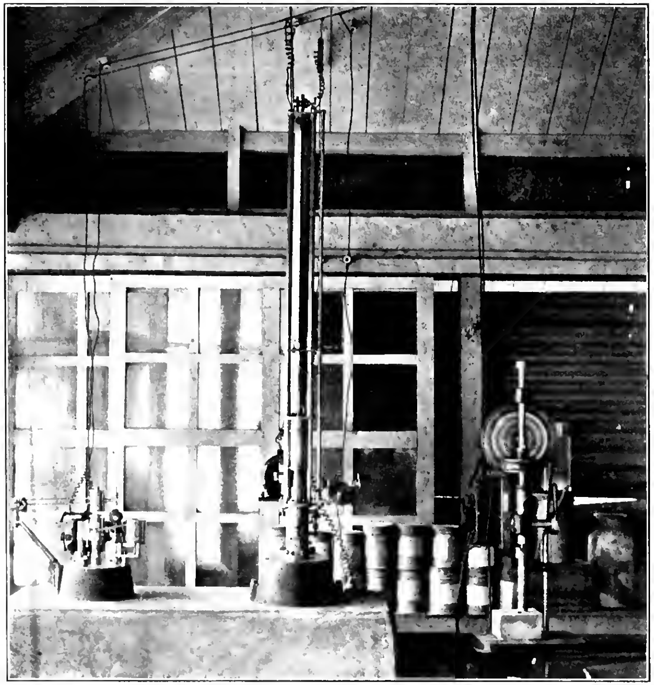

Fig. 1. Machines for testing road materials.

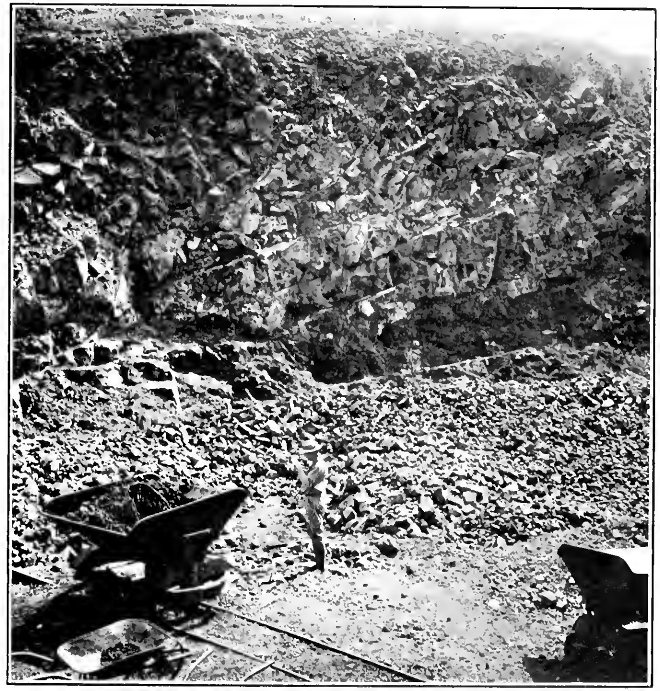

Fig. 2. Rizal Quarry Company's quarry, Rizal Province.

PLATE LV.

PLATE LVI. AN OUTCROP OF COAL, NACIPIT CREEK, ULING COAL FIELD, CEBU.

This seam is 4.75 meters thick, and dips to the west at an angle of about 40°.

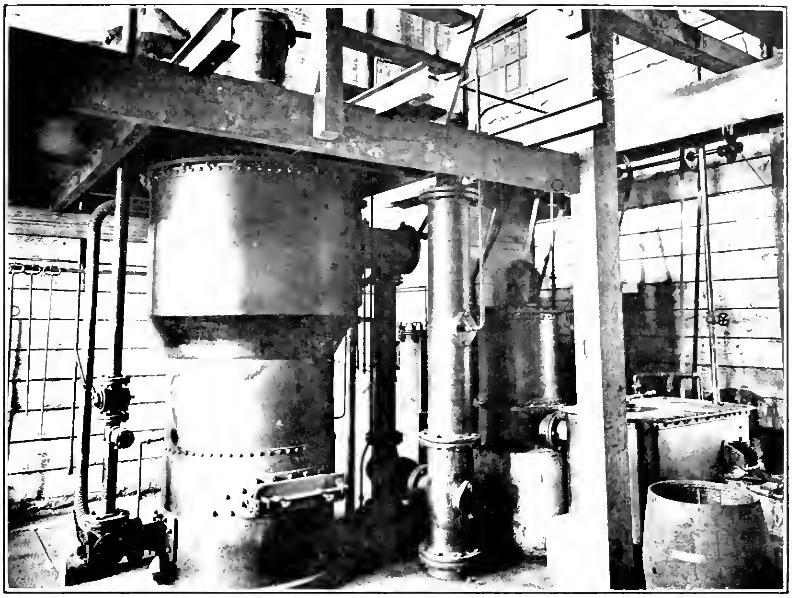

Fig. 1. Producer-gas plant.

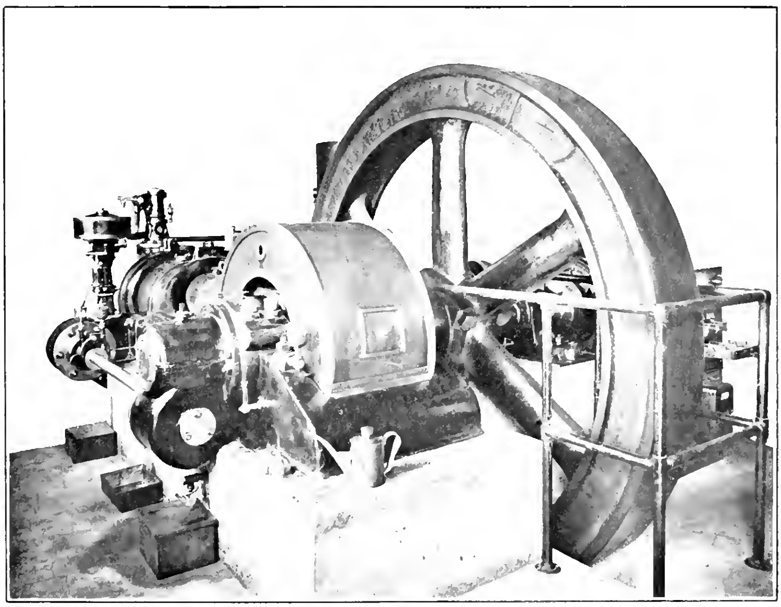

Fig. 2. Engine and dynamo direct coupled.

PLATE LVII.

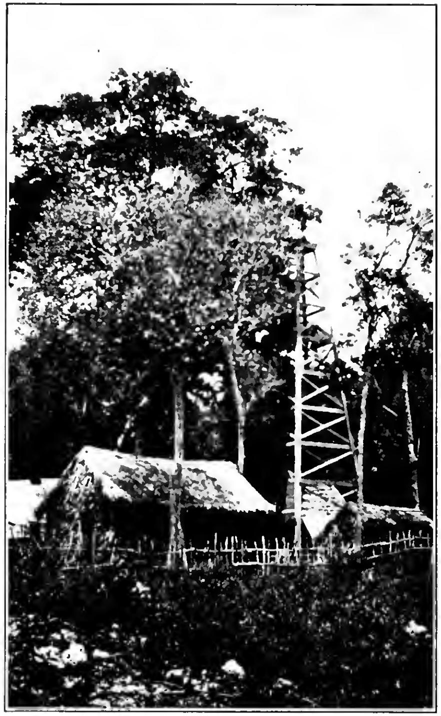

Fig. 1. Bahay well 2, Bahay Valley Oil Company, Bahay, Mulanay, Tayabas.

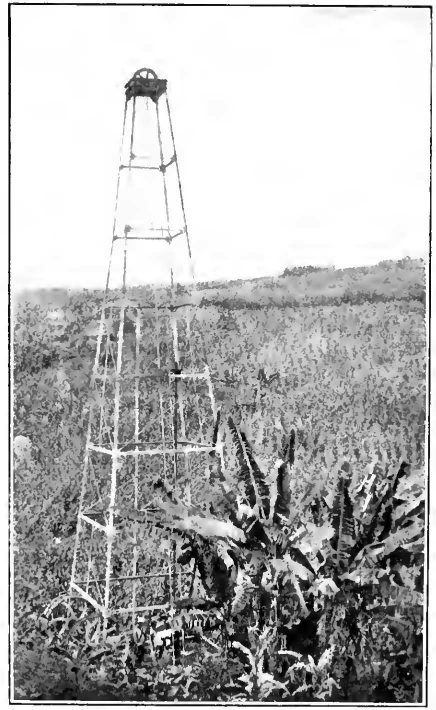

Fig. 2. Steel derrick over one of the wells drilled at Toledo, Cebu, in 1896.

PLATE LVIII.

their utility as a source of fuel or as a lubricant has been discussed. This oil is characterized by a comparatively high proportion of volatile hydrocarbons, a paraffin base, and by being free from sulphur.

71. *Ore deposits.*—The principles controlling the deposition of ores in the Philippines, the localization of pay streaks, the alteration and enrichment in calcite-quartz-manganese deposits, and the extent and probable depth of valuable deposits have been studied. The results of these investigations, particularly those which indicate the life of the mines, are of great practical value in mining operations.

72. *Baguio mineral district.*—A survey of this region has shown the distribution of the various formations and their relation to the topography of the country, mineral veins, types of ore bodies, water-power sites, transportation, timber, nonmetallic deposits, and various structural features such as roads, bridges, and buildings. Owing to the nature of the surface formations and the climatic conditions in the highlands of Luzon, there is an elaborate system of fracturing along complex systems of joints, and weathering extends to very great depths. Had this investigation been carried out sooner and the information been available before the construction of the Benguet Road, it would have been of great assistance; perhaps the road might not have been located where it is at present.

73. *Black sands.*—Studies of the black-sand concentrates, after careful cleaning at the dredges in placer districts, show that values remain which would several times pay for the cost of their shipment and treatment.

74. *Petrography.*—Our petrographic studies of several thousand rocks from all kinds of formations and from all parts of the Archipelago enable us to say how they are likely to behave under wear and stress and to indicate what rocks are suitable materials for road and other construction. By means of a petrographic microscope, it is possible to approximate the composition of a rock and for many purposes avoid a laborious chemical analysis. It is essential to know the kinds of rocks from which soils are derived in order to ascertain the potential plant food, and this can often be done by petrographic study. By this means we have discovered the existence of potash-bearing minerals in the rocks of Aroroy district of Masbate, where we had no previous knowledge of them. This information is of great importance to agricultural regions.

75. *Paleontology.*—In an accurate and reliable survey of economic deposits in sedimentary formations, particularly in coal

and oil fields, use must be made of information concerning the fossils, in the correlation of the strata. Our paleontologic studies have enabled us to correlate the coal and oil horizons of the Archipelago with similar deposits in Java, Borneo, Formosa, Sumatra, and other countries, and to deal intelligibly with facts which otherwise might have been obscure or unintelligible.

76. *Models.*—The Bureau of Science has a number of models of mines and mining appliances consisting of dredges, cyanide mills, blast furnaces, coal and metal mine models, etc. These are being constantly examined by students, prospectors, and laymen, and it is not unusual for such models to be made use of in litigations in explaining disputed points on technical questions.

77. *Engineering geology.*—Investigations have been carried on which clearly demonstrate that the correct interpretation in the location and design of many types of engineering projects is not only desirable but imperative, and the aid of an engineering geologist is often necessary when least expected. Our researches have explained discrepancies between astronomical and trigonometrical stations, and have referred them to the composition and specific gravity of mountain masses, after which the proper compensations and corrections were made.

78. *Physiographic studies.*—These investigations, which grow out of geologic studies, have great application in aiding ethnologists and historians in arriving at accurate and comprehensive conceptions of the factors which control the distribution of races and tribes and the development of their customs and in the correct interpretation of the past and future course of these factors. They should guide legislators in proposing laws and assist capitalists and executives in projecting large constructive economic projects, particularly in opening up new countries.

WORK OF THE FISCAL YEAR

The position of Director of the Bureau of Science, left vacant by the death of Dr. Paul C. Freer on April 17, 1912, has not yet been filled. The Assistant Director, who was appointed Acting Director on May 25, 1913, has continued to direct the affairs of the Bureau during the year.

Considerable attention has been given to the work of landscape gardening, general beautification of the lawns, and to the improvement of the grounds of the Bureau of Science. The dilapidated buildings in the rear have been repaired or removed, unsightly holes have been filled and irregular places leveled, and the hedges replanted. The Bureau of Public Works has overhauled the monkey house and the taxidermist's laboratory—

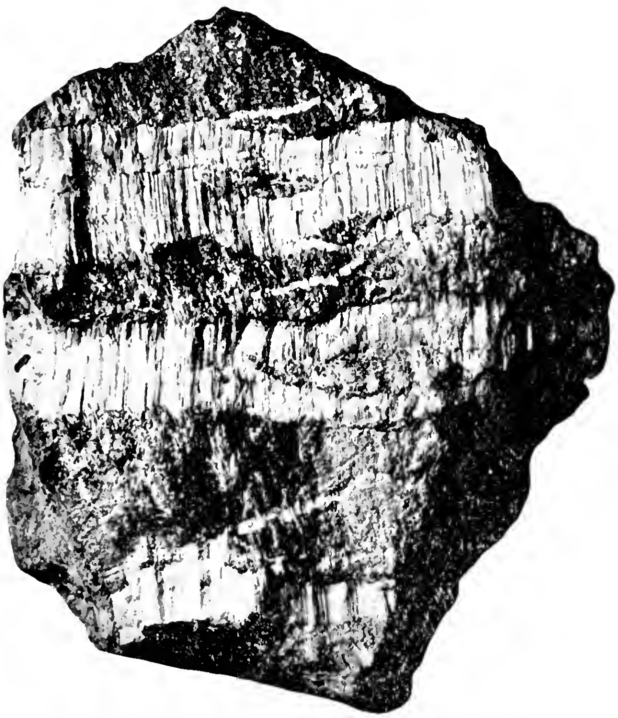

PLATE LIX. CRYSOTILE FROM DUNGU-DUNGAN, ILOCOS NORTE.

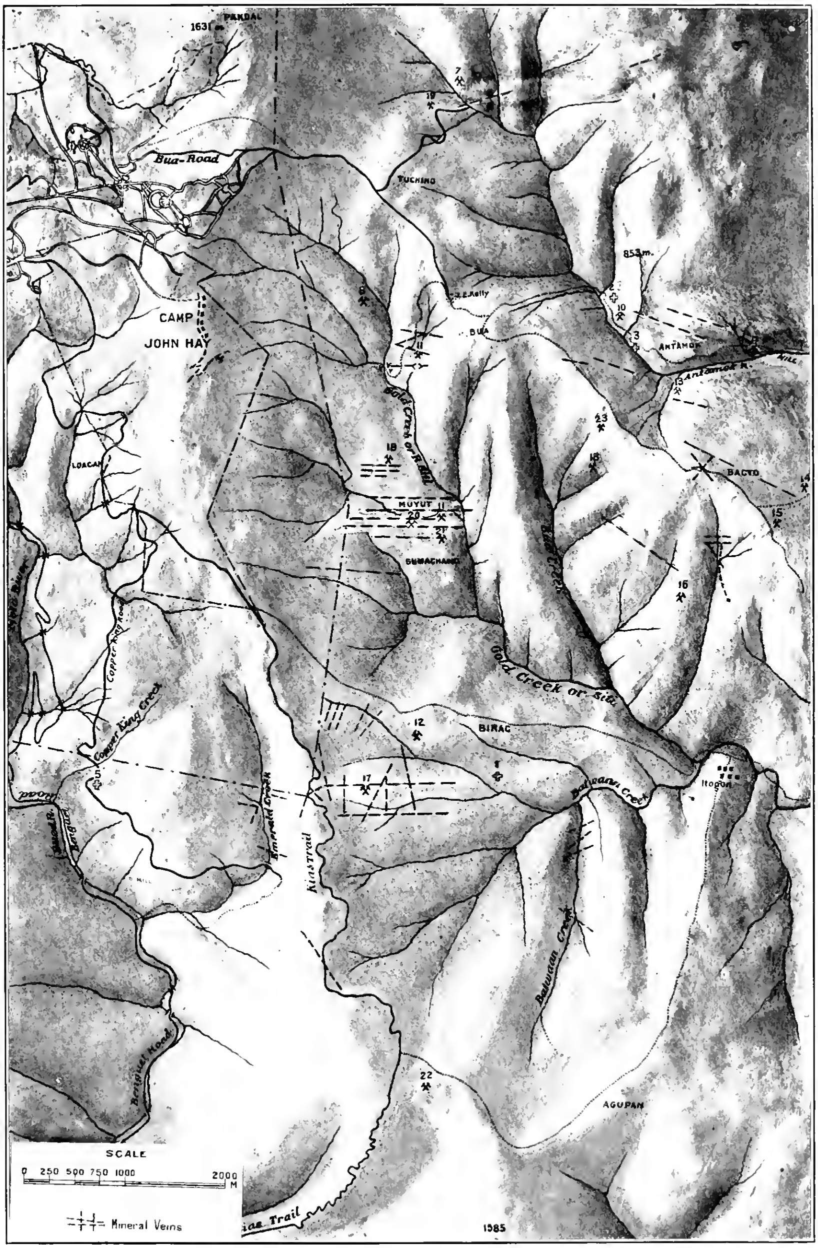

PLATE LX. MINERAL VEINS IN THE BAGUIO MINERAL DISTRICT.

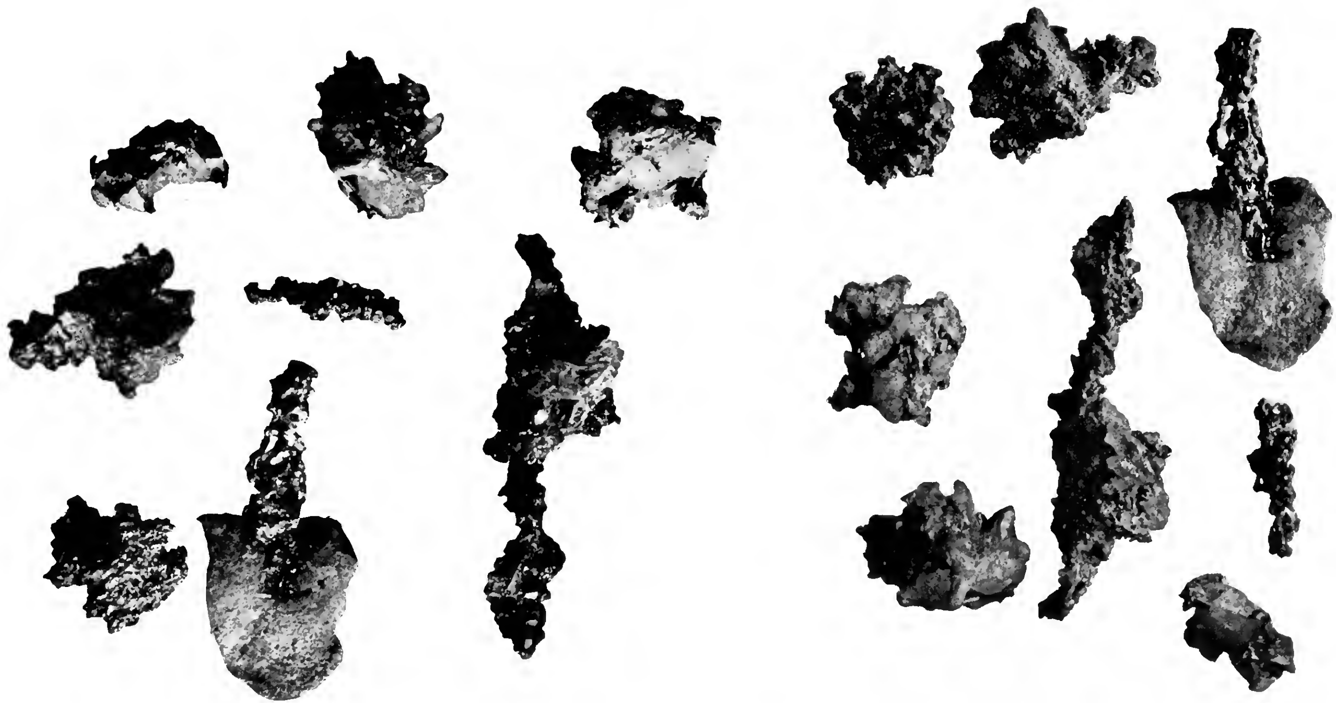

PLATE LXI. GOLD NUGGETS FROM THE PARACALE PLACER DEPOSITS.

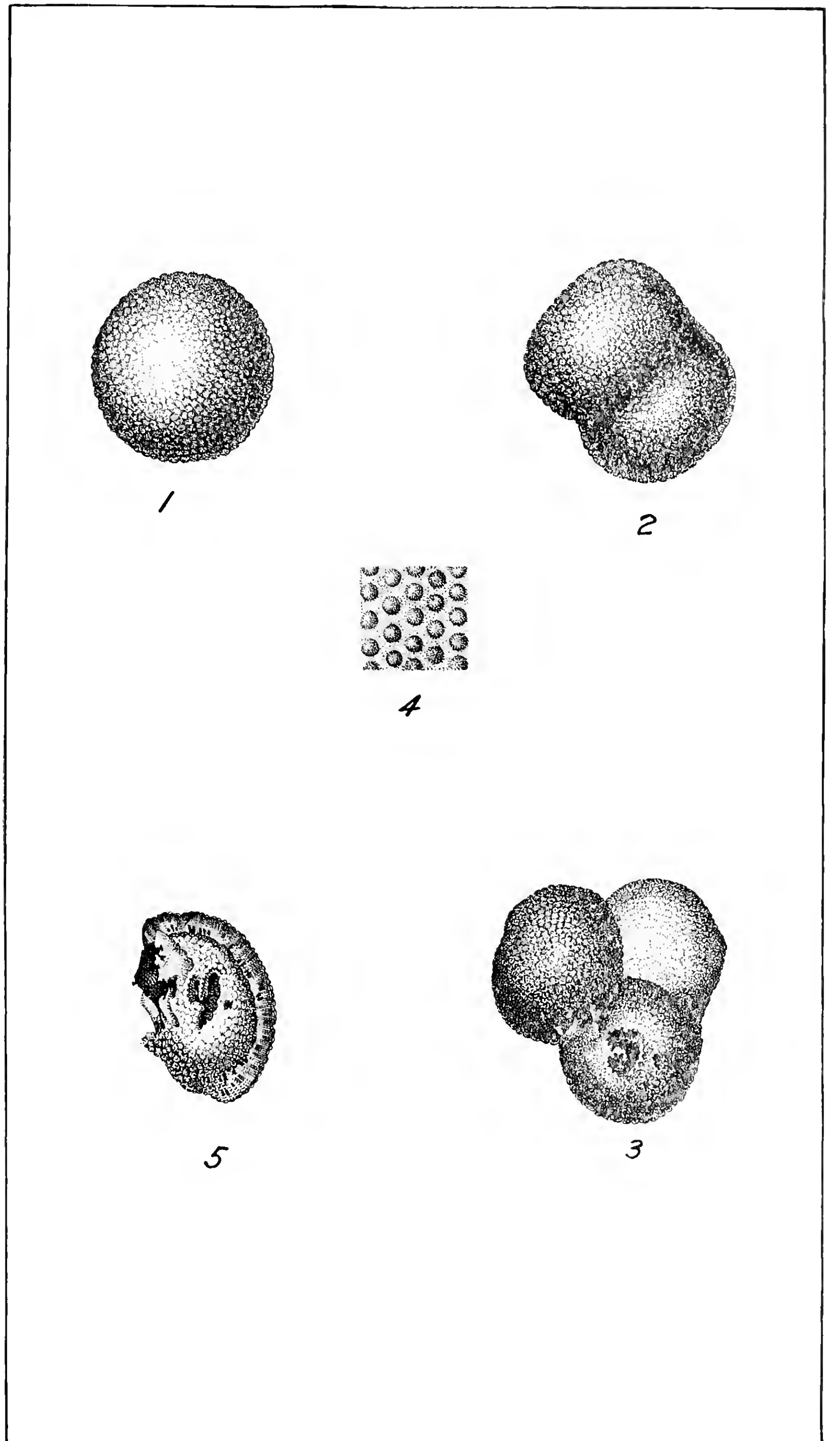

PLATE LXII. GLOBIGERINA, A POSSIBLE SOURCE OF OIL IN TAYABAS.

two of the outbuildings in the rear of the east wing of the main laboratory building—and has provided each with a new cement floor which greatly improves their appearance and usefulness. The tar pits in the rear of the power house have been encased in cement, and a storm drain connecting with the storm sewer on Taft Avenue has been laid to drain the rear of the premises and to receive the water pumped from the tunnel. The filling of the swamp at the corner of Calle Herran and Taft Avenue, next to the east wing, has been completed to a sunken garden grade and will soon be planted to lawn.

The following figures show that the amount of routine work in practically all divisions and sections of the Bureau has increased greatly, and would have seriously interfered with our research work except for the devotion of our scientists who have worked in the afternoons during the hot season, after hours on week days, and on Saturday afternoons and holidays. In view of the great difference in the relative value and necessity of research as compared with most routine work, I regret that our employees have been occupied so largely with the latter, especially as many requests for routine work are founded on a false impression of the value of the specified test. For example, the presence or absence of amœbæ in surface water is being regarded of less and less sanitary significance. The organisms which live in surface water are incapable of living as parasites in the intestines of man, and consequently are not concerned in the production of dysentery. There is no doubt as to the distinction between the pathogenic and the nonpathogenic amœbæ. It follows that the mere presence or absence of amœbæ has little sanitary significance, and the examination should be omitted where practicable. Often the ability of a cement to pass the requirements of specifications does not prove either its actual or relative value; the purity of a paint does not fix its value as a protective coating; the percentage of chlorine does not establish the potability of water; and the bacteria count of a water several hours in transit to the laboratory, unless packed on ice, has no value. We are requested to make chemical analyses of samples and from the results obtained make definite statements concerning such complicated considerations as the rapid corrosion of a piece of galvanized iron, the relative suitability of paints for use in sea water, the value of a mineral paint, of creosote oil, or of tars, asphalts, and bitumens for paving purposes, of Babbitt metals, of lubricating oils, etc. Obviously, it is often impossible to give such information, and inability to do so is sometimes considered as incompetency. My endeavor to dis-

courage requests for analyses and examinations of doubtful value has not always been successful.

In spite of the difficulties, a large amount of research has been carried on in the Bureau of Science and the results published. The titles of all articles published by members of the Bureau of Science during the year are given in one place under the heading of The Philippine Journal of Science and other publications. Changes in the personnel are given under the discussion of that division of the Bureau in which the individual worker was employed. Other than this the names of individuals have been omitted so far as possible. A list of the scientific staff is given on the second page of the cover.

FAR EASTERN ASSOCIATION OF TROPICAL MEDICINE

The first biennial meeting of the Far Eastern Association of Tropical Medicine was held in Manila between the dates of March 5 and 14, 1910. The second congress of this association was held in Hongkong on January 27, 1912. Both of these sessions were well attended, and the papers which were read treated of a great variety of subjects and stimulated much interesting discussion. Many of the papers of the association have been published in The Philippine Journal of Science. These meetings demonstrated conclusively the great benefit to the Orient which can be derived from an organization of this kind, and the subjects discussed are of the greatest interest and importance to the Philippine Islands. The third congress of the association will be held in Saigon from November 8 to 15, 1913, and Dr. E. L. Walker of this Bureau has been appointed by His Excellency, the Governor-General, as one of the delegates from the Philippine Islands.

BIOLOGICAL LABORATORY

Personnel.—Dr. R. P. Strong, chief of the biological laboratory of the Bureau of Science, who went on leave on account of illness in July, has resigned to accept a position as chief of the department of tropical medicine in Harvard University Medical School. Dr. B. C. Crowell, pathologist in this laboratory, has been detailed for one-half of his time as chief of the department of pathology and bacteriology in the College of Medicine and Surgery of the University of the Philippines. Mr. Ariston M. Guzman left Manila on leave for the Bennett Medical College, Chicago, on May 16, 1913, where he has registered for medical work. The resignation of Mr. Porter Leaky was accepted April 15, 1913. Dr. John A. Johnston, from the laboratory of hygiene, University of Pennsylvania, was appointed

assistant in the biological laboratory, and assumed his duties November 11, 1912. Mr. Lyle D. McMillan was transferred from the Bureau of Education to the biological laboratory of this Bureau June 5, 1913. Three assistants in the routine laboratory have left during the year and have been replaced by other men. The position of chief of the biological laboratory and a few other vacancies remain unfilled.

All of the instruction in medical zoölogy in the College of Medicine and Surgery and in the Graduate School of Tropical Medicine and Public Health of the University of the Philippines is given by members of the staff of the biological laboratory of the Bureau of Science. The courses given in the undergraduate school of medicine include—

1. A course in protozoölogy, occupying 3 hours a week during the second semester.
2. A course in helminthology, occupying 9 hours a week during the first semester.
3. A course in medical entomology, occupying 2 hours a week during the first semester.

In the Graduate School of Tropical Medicine and Public Health, the courses in protozoölogy and helminthology will occupy in the class room and laboratory at least 12 hours a week throughout the year, and the course in medical entomology at least 24 hours a week for six weeks, exclusive of the preparation of lectures and of material for laboratory work which requires at least as much more time.

ROUTINE WORK

The routine work is constantly increasing and occupies more and more of the available staff of this laboratory. It showed an increase in 1912 of 45 per cent above that of the year before, and there has been a still greater increase during the past year, as shown by the table on page 46. Branch laboratories are still maintained at the Philippine General Hospital and at Bilibid Prison Hospital to handle the large amount of clinical laboratory work at these institutions. An assistant from the laboratory has been detailed to make bacteriological examinations on each trip of the Bureau of Health to collect lepers.

The following table shows the number of routine examinations made during the past, and, for comparison, during the preceding fiscal year. The classification of these examinations for the year of 1912 was less exact, many of the samples classified in this table being put under miscellaneous. This accounts for the blank spaces in the 1912 column.

Nature of examination.	1912	1913
Blood	3,951	23,450
Blood culture		226
Widal test		388
Wassermann test		727
Urine		6,974
Sputum	3,925	5,770
Fæces	22,733	34,530
Gonococci	15,971	20,522
Leprosy		848
Plague		45
Rats for plague		(a)
Rabies		11
Autopsy	59	130
Histological examination	455	606
Water	742	1,077
Miscellaneous	4,594	57,916
Total	51,941	153,220

[a] Included under miscellaneous.

In many cases the requests accompanying these samples were for more than one kind of examination; as, for example, red corpuscle count, total and differential white corpuscle count, hæmoglobin determination, and malarial parasites in one sample of blood; or, *Trichuris*, *Ascaris*, *Ankylostoma*, monads, amœbæ, *Strongyloides*, *Oxyuris*, *Tænia*, *Opisthorchis*, *Balantidium*, blood cells, mucus, and pus in one sample of fæces. Therefore, the table does not indicate the total number of examinations made, but only the number of requests received.

INVESTIGATIONS

On account of the vacancies in the staff and the constantly increasing amount of routine work in the laboratory, it has been necessary repeatedly to take men from research work to help with the routine work or to send into the field to make special investigations. This has in many cases seriously interfered with the research work that was being conducted.

Plague.—In the course of the plague outbreak during the past year, some investigations were made on the diagnosis, transmission, and pathology of bubonic plague. The importance of blood culture and the uselessness of the agglutination test in the diagnosis of plague, the part played by phagocytosis in the resistance of man to plague infection, and the presence of numerous plague bacilli in comparatively insignificant skin lesions which indicate the possibility of direct infections with bubonic plague have been demonstrated. The rôle of rat fleas

in the transmission of bubonic plague has received further confirmation from the study of an outbreak of plague among guinea pigs in the animal house, in which transmission by rat fleas was demonstrated and in which all other methods of transmission were excluded. The finding of a naturally infected plague cat confirms the belief that these animals might be a source of infection to man in plague epidemics. An extended pathological study of the lesion of bubonic plague, as found in the human cases during this outbreak, is now in progress by the pathologist of this laboratory.

Cholera.—A new and quicker procedure in the isolation and identification of the vibrio of Asiatic cholera has been devised, but owing to the absence of cases of this disease in the Philippines the work is unfinished. The method depends on the separation of cholera vibrios from other bacteria by the use of agglutinating serums in pipettes and by making use of the positive chemiotaxis of cholera vibrios in the presence of certain substances. The importance of the earliest possible diagnosis of cholera in preventing the spread of the disease is recognized, and this new method promises to be of material aid to this end.

Bacillary dysentery.—A study has been made of morphological and biological variations in strains of *Bacillus dysenteriæ,* isolated by the single-cell method. Several strains have been isolated which showed morphological variations and differences in their capacity to ferment carbohydrates, and certain of these varieties have been found to be constant. This work has a practical bearing on the diagnosis of dysentery. An investigation of the bacteriology of infantile diarrhœas is now in progress.

Infection studies with the bacteria of cholera, dysentery, and plague and with *Bacillus pyocyaneus* and *Aspergillus* injected into the cells of the mold *Achlya* have been carried on. They included principally a study of the permeability of the walls of the plant for agglutinins and acids with the treatment of infections by these substances.

Tuberculosis.—A study of tuberculosis infection in animals has demonstrated the greater resistance of guinea pigs to infection with bacilli from human sources under conditions obtaining here than in temperate climates, and an attempt to immunize guinea pigs with virulent cultures of tuberculosis has resulted negatively. Also, a study of the occurrence of tuberculosis associated with leprosy and the investigation of a strain of tubercle bacilli from a leprous patient which has produced a

remarkable enlargement of the spleen of infected guinea pigs have been carried on.

Leprosy.—A study is being made of the organisms cultivable from leprous tissues, with especial reference to classifying the organisms cultivated from such sources by different authors and to determining the etiologic relationship of such organisms to leprosy.

Entamœbic dysentery.—The investigation of entamœbic dysentery, which has extended over a period of nearly three years, has been completed and will be published in six parts, occupying the whole of No. 4, Section B, The Philippine Journal of Science, of the current year under the title Experimental entamœbic dysentery.

Part I. Introduction.
Part II. Feeding experiments with cultures of amœbæ.
Part III. Feeding experiments with *Entamœba coli.*
Part IV. Feeding experiments with "*Entamœba tetragena*" and *Entamœba histolytica.*
Part V. Applications of the results to the diagnosis, treatment, and prophylaxis of entamœbic dysentery.
Part VI. Summary and conclusion.

Balantidiasis.—As indicated on page 20 little is known about the epidemiology of balantidiasis. The infection presents the following problems which are under investigation:

1. The frequency of human infections with *Balantidium coli* in the Philippine Islands.
2. The presence of the parasite in the domesticated pig in the Philippines.
3. The question of the identity of the balantidium of the pig and of man.
4. The part played by the pig in the dissemination of the infection to man.
5. The experimental infection of animals.
6. The ability of *Balantidium coli* to penetrate the sound intestinal epithelium.
7. The pathogenesis of *Balantidium coli.*
8. The cause and nature of the latent infections with this parasite.
9. The early, preulcerative, pathology of balantidiasis.
10. The treatment of balantidiasis.

The results of a portion of this work have been published in The Philippine Journal of Science. Investigations are now in progress which promise to throw much light upon the other problems presented by this parasitic disease.

Malaria.—In January of the present year a joint commission of representatives from the Bureau of Science, the Bureau of Health, and the College of Medicine and Surgery of the University of the Philippines made a sanitary survey of the San José estate and adjacent properties in Mindoro, with special

reference to malaria. The part taken by the Bureau of Science in this investigation includes:

1. A topographical survey with maps of the region.
2. An entomological survey, with especial reference to the habits and breeding places of flies and mosquitoes capable of transmitting malaria.
3. The collection and microscopic examination of blood smears for malarial parasites from 1,098 persons.
4. The examination of a limited number of stool specimens to determine the intestinal parasite index.
5. A study of the comparative value of the "spleen index" and of microscopic examination of the blood in the diagnosis of malaria.

The results of the investigation of this commission, which will supply an important contribution to the epidemiology of malaria and to the prophylaxis of the disease as it exists in the Philippine Islands, will appear in an early number of Section B of The Philippine Journal of Science.

Surra.—An investigation of the therapeutic action of certain drugs and chemicals upon surra has been undertaken, but is at present suspended awaiting the arrival of chemicals from abroad.

Helminthology.—The essential facts of the life history of the worm (*Œsophagostomum apiostomum*) of the nodular intestinal disease, which is a frequent parasite of apes and occasionally of man, have been worked out, and experiments are in progress to determine the methods of infection with this parasite. It is probable that the larva is capable of penetrating the skin of man as is the case of the larva of the hookworm.

The domesticated pig as a "carrier" of infections.—It is already known that the pig is a source of infection to man in the case of the pork tapeworm (*Tænia solium*) and the muscle worm (*Trichinella spiralis*), but no definite knowledge is had of the rôle it plays in the spread of other diseases and parasites. The fact that domesticated pigs commonly live near or under the houses of Filipinos and the part the pig plays as a scavenger in the Philippine Islands have led us to investigate the possibility of these animals becoming infected with, and acting as "carriers" of, intestinal diseases and parasites communicable to man. The present investigation included a determination of the intestinal parasites occurring naturally in the pig, and experiments with bacillary dysentery, cholera, entamœbic dysentery, and balantidiasis, and with the hookworm and other intestinal worms. The results of these experiments have led to the conclusions that the domesticated pig cannot be infected with, and consequently plays no rôle in the dissemination of, cholera, bacillary dysentery, entamœbic dysentery, or hookworm

infections, but that this animal is the chief source of infection of man with *Balantidium coli* and, probably, also with *Strongyloides stercoralis.*

Outbreak of disease in Ambos Camarines.—In October an expedition was made to Buhi, Ambos Camarines, to study an unusual epidemic disease reported by a local health officer. Several fatal cases had occurred previous to the expedition, and about 18 cases of a peculiar inflammatory disease said to be the same as that causing earlier fatal cases were found. These cases were studied clinically, and microscopical examinations and animal inoculations were made. Plague and anthrax were excluded. The positive findings were few, except that pyogenic organisms were demonstrated in the lesions. The disease may be a remarkable type of pyogenic infection or possibly pyogenic bacteria may simply accompany this disease of unknown cause.

Artesian wells.—Bacteriological examinations of 35 artesian wells in the Provinces of Bulacan, Rizal, and Cavite, with the object of determining if any are subject to pollution, resulted in the discovery that all flowing wells have water of extraordinary bacterial purity, approaching, if not attaining, sterility in most cases. The nonflowing wells examined also show low bacterial count and no signs of pollution except in the well at Bocaue, where there is strong evidence of pollution.

Sickness at Cabanatuan.—Unfinished investigation of enteritis, with personal experience with the disease, occurring on a hacienda near Cabanatuan, Nueva Ecija, indicates toxins of bacterial origin occurring in the milk of a certain cow as the cause. Dysentery, mineral poison occurring in the well, or ptomaines other than those formed in milk or cream seem well excluded.

Locust-exterminating bacterium.—*Coccobacillus acridiorum* d'Herelle, of which a culture was obtained from Argentine Republic by the Honorable, the Secretary of the Interior, has been used in a series of inoculation tests and in ingestion experiments on locusts—in pens in the laboratory and in swarms in the open field—in nearly all stages of development and under various conditions of weather. The practical results have been negative. In the very few partially positive field experiments the percentage of insects that died was small and there seemed no tendency for the infection to spread in the swarm. If this infection has succeeded elsewhere, its failure here may be due (1) to meteorologic conditions or (2) to a difference in the species of locust. Mr. C. R. Jones of the Bureau of Agriculture coöperated with us in this work.

Pathology.—In addition to the pathological study of bubonic plague mentioned under that head, pathological investigations have been made of status lymphaticus among Filipinos, of intestinal parasites in 500 autopsies, and pathological examinations of material from the surgical clinic of the Philippine General Hospital. Six hundred six histological examinations of surgical pathology specimens were made in connection with the latter work, of which a detailed analysis for once is here given.

		Cases.
Abortion		4
Adenoma		6
Thyroid	5	
Uterus	1	
Adenocystoma		16
Thyroid	11	
Ovary	5	
Adenofibroma		4
Breast	4	
Adenomyoma		2
Uterus	2	
Adenomyxoma		1
Neck	1	
Appendix		269
Normal	10	
Incidental removal	52	
Appendicitis—		
Acute	61	
Chronic	130	
Subacute	13	
Tuberculous	3	
Axilla		1
Cyst, Teratoma	1	
Back		1
Probable tuberculous abscess	1	
Bone		1
Osteomyelitis		1
Bursa		2
Bursitis—		
Chronic, elbow	1	
Tuberculous, hip	1	
Broad ligament		1
Abscess	1	
Calculi		38
Vesical	37	
Renal	1	
Carcinoma. (*See* Intestine, Liver, Lymphatic glands, Mammary gland, Nose, Ovary, Parotid gland, Thyroid, Uterus.)		
Cervix uteri		46
Amputations and repairs for lacerations, cervicitis, and hypertrophies	39	
Malignant adenoma	1	
Epithelioma	4	
Polyps (fibromyoma)	2	
Curettings, uterine		44
Cysts—		
Bartholini's gland. (*See* Vulva.)		
Dermoid. (*See* Axilla, Ovary, Vulva.)		
Fallopian tube. (*See* Fallopian tube, Hydrosalpinx.)		
Ovarian. (*See* Ovary, Cysts.)		
Parovarian. (*See* Parovarium, Cysts.)		
Sebaceous. (*See* Skin, Sebaceous cysts.)		
Thyroid. (*See* Thyroid, Cysts.)		
Tuberculous	2	
Thigh	1	
Shoulder	1	
Ear		2
Epithelioma, papillary	2	
Endothelioma. (*See* Meninges, Parotid gland and Submaxillary gland tumors, and Skin.)		
Epididymis		4
Epididymo-orchitis—		
Tuberculous	3	
Chronic	1	
Epithelioma. (*See* Skin, epithelioma; Cervix uteri, epithelioma; Tonsils, epithelioma; Neck, tumors; Ear, epithelioma; Nose, polyp.)		

		Cases.
Eye		5
Hypopyon	1	
Sarcoma	2	
Panophthalmia	1	
Glioma retina	1	
Fallopian tubes		33
Hydrosalpinx	2	
Hæmatosalpinx	2	
Perisalpingitis, chronic	7	
Salpingitis—		
Acute suppurative	2	
Chronic	16	
Tuberculous	2	
Tubal gestation	2	
Finger		2
Supernumerary thumb	1	
Corn on thumb	1	
Gall bladder		4
Cholelithiasis	3	
Cholecystitis, chronic	1	
Granuloma		4
Ulcerative granuloma pudendi	2	
Leg, undetermined	1	
Foot, undetermined	1	
(*See* Leprosy, Syphilis, Tuberculosis.)		
Gum		2
Epulis, fibroma	1	
Dentigerous cyst	1	
Hæmangioma		4
Intraocular	1	
Submaxillary region	1	
Intramuscular	1	
Cheek	1	
Hæmangiofibroma		2
Palm of hand	1	
Lower lip	1	
Intestine		6
Carcinoma, scirrhous	1	
Gangrene, strangulated hernia	1	
Lymphosarcoma	1	
Tuberculosis (cæcum)	2	
Foodstuff from enema	1	
Joints		1
Arthritis, chronic, elbow	1	
Kidney		1
Nephrolithiasis	1	

			Cases.
Lachrymal gland			1
Andenitis, chronic		1	
Leg			1
Sarcoma, spindle-celled		1	
Leprosy			1
Skin		1	
Lipoma			3
Forehead		1	
Back		1	
Leg (4,470 grams)		1	
Liver			3
Syphilis		1	
Carcinoma		1	
Abscess		1	
Lympathic glands			52
Carcinoma—			
Secondary		9	
Axillary, metastatic from breast	7		
Cervical metastatic from thyroid	1		
Mesenteric metastatic from (?)	1		
Lymphadenitis—			
Acute		3	
Suppurative, cervical	1		
Syphilis, inguinal	1		
Hyperplastic, axillary	1		
Lymphadenitis—			
Chronic		3	
Femoral	1		
Mesenteric	1		
Submaxillary	1		
Sarcoma		5	
Abdominal	1		
Axillary, secondary	1		
Cervical, secondary	2		
Mesenteric, secondary	1		
Tuberculosis		31	
Axillary	3		
Cervical	23		
Femoral	1		
Mesenteric	3		
Submental	1		
Syphilis		1	
Femoral	1		

		Cases.
Mammary gland		15
Adenofibroma	4	
Carcinoma	11	
Meninges		1
Endothelioma, dura mater	1	
Mesentery		1
Cyst	1	
Neck		7
Adenomyxoma	1	
Epithelioma	1	
Branchiogenic	2	
Mucocele (?)	1	
Sarcoma, round-celled	1	
Sebaceous cysts	1	
Nerves		3
Neurofibroma	3	
Nose		6
Papillary carcinoma	1	
Nasal—		
Polypus	4	
Carcinoma	1	
Omentum		1
Fibrosarcoma, secondary	1	
Ovary		57
Abscess	1	
Carcinoma	2	
Cyst, dermoid	2	
Cystadenoma, papillary	5	
Cystoma—		
Multilocular	11	
Simple	9	
Oöphoritis—		
Acute	3	
Chronic	19	
Tuberculous	2	
Teratoma	2	
Fibroma with hæmorrhage	1	
Papilloma. (*See* Skin, papilloma; Vulva, papilloma.)		
Parotid gland		7
Carcinoma	2	
Mixed tumors	4	
Endothelioma	1	
Parovarium		11
Cysts	11	
Prostate gland		1
Prostatitis, chronic hyperplastic	1	

		Cases.
Sarcoma. (*See* Lymphatic glands, Intestine, Leg, Skin, Testis.)		
Skin		46
Adenocarcinoma originating from mucous gland	1	
Corns	2	
Epithelioma	12	
Fibroma	3	
Granuloma	4	
Hæmangiofibroma	2	
Leprosy	1	
Nævus	1	
Papilloma	3	
Sarcoma	8	
Sebaceous cyst	5	
Syphilis	2	
Tuberculosis	2	
Spleen		1
Splenomegaly, endothelial hyperplasis in splenic anæmia	1	
Submaxillary gland		2
Mixed tumors	2	
Syphilis		3
Lymphatic gland	1	
Skin	2	
Tendon		6
Tenosynovitis—		
Chronic	5	
Tuberculous	1	
Testis		6
Tuberculosis	5	
Sarcoma	1	
Thyroid		44
Adenoma	5	
Carcinoma	8	
Colloid goitre	16	
Cystadenoma	11	
Cysts, simple	4	
Tonsil		3
Epithelioma	2	
Tonsillitis, chronic	1	
Tongue		2
Carcinoma	2	
Tuberculosis. (*See* Epididymis, Fallopian tubes, Lymphatic glands, Ovary, Skin, Testis, Uterus, Vas deferens.)		

		Cases.
Tunics of testis		3
Hydrocele	3	
Urethra		2
Polyp	2	
Uterus		34
Adenomyoma	2	
Carcinoma fundus	1	
Epithelioma cervix	1	
Fibromyoma largest, 15.5 kilograms	15	
Hydatid mole	1	
Hydrometrium from adenoma cervix	1	
Lipomyoma	1	
Metritis	4	
Malignant adenoma cervix	1	
Uterus—Continued.		
Myoma	5	
Tuberculosis	2	
(*See* Cervix uteri, Curettings, uterine.)		
Vas deferens		1
Tuberculosis	1	
Vulva		4
Cyst—		
Dermoid	1	
Bartholini gland	1	
Epithelioma	1	
Papilloma	1	

Immunity.—The study of the duration of passive immunity against tetanus toxin has been continued, and the following conclusions reached:

1. The subcutaneous injection of 1,500 units of antitetanic serum from horse into horse confers passive immunity of between six and eight weeks' duration.
2. Guinea pigs subjected to repeated inoculations with antitetanic serum from horse do not acquire the power to eliminate it more rapidly; they acquire a tolerance as is shown by the longer period of immunity.
3. After repeated injections of normal horse serum into guinea pigs, passive immunity, following the injections of antitetanic serum from horse, is of longer duration than it is in untreated guinea pigs.

A comparison of the different modifications of the Wassermann test for syphilis has been made for the purpose of determining their relative value and reliability. In confirmation of the results of other investigators, methods in which unheated serum is used give a much higher percentage of positive results than those in which heated serum is used.

Serums and vaccines.—The preparation of variola vaccine (vaccine virus) was continued throughout the year. Cholera prophylactic, plague prophylactic, gonococcus vaccine, staphylococcus vaccine, typhoid vaccine, and streptococcus vaccine were prepared in moderate quantities. Anthrax vaccine, tuberculin (both human and bovine), and mallein were continually kept on hand.

Antidiphtheritic, antitetanic, anticholera, antityphoid, antiplague, antidysenteric, and antistreptococcic sera were made in quantities sufficient to supply the demand.

Typhoid, paratyphoid, and cholera reagents (killed cultures) for agglutination; agglutinating sera, in liquid and in dried form, for the purpose of diagnosing infectious diseases and identifying bacteria; as well as normal sera of horse, ox, sheep, and goat were always kept on hand. Other sera, such as those of dog, cat, rabbit, and guinea pig, are supplied on request. Sterile blood or washed blood corpuscles of horse, ox, sheep, goat, rabbit, and guinea pig are also furnished on request.

Rabies.—The work on rabies was continued throughout the year. Thirty-six patients applied for the Pasteur treatment during the year.

BOTANICAL SECTION OF THE BIOLOGICAL LABORATORY

Personnel.—Mr. E. D. Merrill, chief of this section, was detailed in July, 1912, for one-half of his time to duty in the University of the Philippines as acting head of the department of botany, College of Liberal Arts, with the title of associate professor of botany. The chief objection to the plan is that it has decreased the time available for research work. Dr. C. B. Robinson, formerly economic botanist, who resigned August 18, 1911, was reinstated, reporting for duty November 15, 1912, which partially compensates for the loss of time for research by Mr. Merrill. At this time the positions provided for in the botanical staff being all filled, Doctor Robinson's appointment was made possible by arrangement with the University of the Philippines, by which the Bureau of Science undertook to provide, by detail, an assistant in botany for the College of Liberal Arts. Mr. P. W. Graff, mycologist, was detailed to give the necessary assistance in the classes in botany, acting as assistant in two laboratory courses.

The herbarium.—The growth of the herbarium has been eminently satisfactory, but the following summary does not include about 1,100 numbers secured in Palawan. A total of 12,807 specimens have been poisoned, mounted, and added in the past year from the following sources:

Collections of employees of the Bureau of Science	5,066
Collections of employees of the Bureau of Forestry	1,065
Miscellaneous Philippine material, received by gift, by purchase, and for identification	2,799
Extra-Philippine material received in exchange and by gift	3,877
Total	12,807

Of the miscellaneous Philippine collections mentioned above, specimens were received from the following sources:

Father M. Vanoverbergh, Lepanto and Bontoc plants for identification	383
Father F. Sanchez, Benguet plants for identification	24
A. D. E. Elmer, purchased	512
Federico R. Bona, Lepanto plants for identification	153
E. D. Merrill, Century XII Philippine Plants	100
C. F. Baker, flowering plants (for identification) and fungi (presented)	653
F. C. Gates, for identification, chiefly from Laguna Province	798
O. F. Sevrens, Benguet plants for identification	81
J. P. Eskridge, Negros plants for identification	57
Miscellaneous	38
Total	2,799

The extra-Philippine material received in exchange has proved to be especially valuable. The most valuable exchanges, for our purposes, have been those received from the Botanic Garden at Edinburgh, Scotland, and from the Botanic Garden at Buitenzorg, Java, the former institution sending plants from India and from China, the latter plants from Java. Following is a summary of the extra-Philippine material:

S. F. Light, Manila, Japanese plants, presented	25	
National Herbarium, Melbourne, Victoria, Australian plants, exchange	50	
H. Winkler, Breslau, Germany, Bornean plants, exchange	106	
C. G. Lloyd, Cincinnati, Ohio, American and European fungi	24	
H. H. Travers, New Zealand plants from Prince Roland Bonaparte, exchange	100	
E. J. Butler, Pusa, India, Indian fungi, exchange	100	
J. Kneucker, Karlsruhe, Germany, Glumaceae exsiccatae	274	
Carnegie Museum, Pittsburgh, Pa., O. E. Jennings, Isle of Pines plants, exchange	126	
Mauritius Forestry Department, Mauritius plants, exchange	76	
Field Museum of Natural History, Chicago, Ill., tropical American plants, exchange	102	
Rev. C. King, Ambasi, Papua, New Guinea plants, exchange	119	
Royal Botanic Garden, Kew, England, fungi, exchange	59	
Botanical Institute, Imperial University, Tokyo, Japan, Liu Kiu plants, exchange	238	
United States National Herbarium, Palmer and Riley, Cuban plants, exchange	140	
H. Yanagawa, Koshun, Formosa, Formosan plants, exchange	121	
Buitenzorg Botanical Garden, Javan plants, exchange	530	
		2,190

Royal Botanic Gardens, Edinburgh, Scotland:		
E. E. Maire, Yun-nan-sen, China	612	
J. M. Dalziel, China	43	
Walker-Arnott, India	33	
Wight, India	191	
Walker, Ceylon	166	
J. C. Prazer, Burma	104	
Miscellaneous	163	
		1,312
H. and P. Sydow, Berlin, Germany:		
Phycomyceten and Protomyceten	25	
Uredineen	300	
Fungi exotici exsiccati	50	
		375
Total		3,877

A large collection of plants, some 800 in number, made by Mrs. M. S. Clemens in the Provinces of Shantung and Chihli, China, has not been recorded as no opportunity has been had to arrange the material in sets for identification and distribution.

The total number of specimens now in the herbarium is 119,386, of which about 75,500 are Philippine.

Loans and distribution of duplicates.—Comparatively few requests have been received for loans of mounted material, the following being the summary of sheets loaned during the year:

Philippine Lycopodium to Dr. W. Herter, Porto Alegre, Brazil, for an enumeration of the Philippine forms	222
Nepenthes to Dr. J. M. Macfarlane, University of Pennsylvania	5
Cissus to Dr. H. Hallier, Leiden, Holland, for critical comparisons with Blume's Javan types	36
Sporobolus to F. T. Hubbard, Cambridge, Mass	40
Derris to S. T. Dunn, Kew, England, for a monograph of the genus	20
Grewia to J. R. Drummond, Kew, England	6
Orchidaceae to Oakes Ames, North Easton, Mass., for identification and critical study	334
Total	663

The following material has been sent to the specialists indicated for monographic purposes or for purposes of identification:

Ferns to Dr. E. B. Copeland, Los Baños, Luzon	216
Mosses to Dr. V. F. Brotherus, Helsingfors, Finland	242
Lichens to Dr. E. A. Wainio, Helsingfors, Finland	97
Fungi to Dr. H. Sydow, Berlin, Germany	797
Piperaceae to C. DeCandolle, Geneva, Switzerland	86
Nepenthes to Dr. J. M. Macfarlane, Philadelphia, Pa	14
Gesneriaceae to Dr. Fr. Kränzlin, Berlin, Germany	12

Araceae to Dr. A. Engler, Berlin, Germany	27
Selaginella to Dr. G. Hieronymus, Berlin, Germany	65
Dioscorea to I. H. Burkill, Singapore	9
Bambusae to J. S. Gamble, East Liss, England	10
Asclepiadaceae to Dr. R. Schlechter, Berlin, Germany	56
Pandanaceae to Dr. U. Martelli, Florence, Italy	26
Palmae to Dr. O. Beccari, Florence, Italy	33
Lycopodium to Dr. W. Herter, Porto Alegre, Brazil	11
Cyperaceae to Rev. G. Kükenthal, Coburg, Germany	64
Menispermaceae and Anonaceae to Dr. L. Diels, Marburg, Germany	100
Symplocos to Dr. A. Brand, Sorau, Germany	8
Capparidaceae, Urticaceae, etc. to Dr. Hallier, Leiden, Holland	174
Total	2,047

In the course of the year somewhat over 10,000 identifications have been made, for the most part Philippine plants but including also material from Guam, New Guinea, Java, Formosa, and Borneo. Most of the specimens identified have been deposited in the herbarium, but a great number of additional plants, not preserved, have been identified for the Bureau of Education, of Forestry, and of Agriculture. Several hundred specimens belonging to the herbarium of the College of Agriculture at Los Baños also have been identified.

A determined effort was made to complete the labels and distribute our accumulated duplicates into sets for distribution, as no large distribution of duplicates was made in the preceding year. This work was accomplished, and the work of distribution practically twice that of the former year was completed by April. The following material has been sent out on our general exchange account:

United States National Museum, Washington, D. C.	1,926
New York Botanical Garden, Bronx Park, New York	717
Royal Gardens, Kew, England	2,156
Kgl. Bot. Garten, Berlin, Germany	2,052
Royal Botanic Garden, Calcutta, India	615
United States Dept. of Agriculture, Washington, D. C.	265
's Lands Plantentuin, Buitenzorg, Java	876
Botanic Garden, Sydney, N. S. W., Australia	238
British Museum, Natural History, London, England	1,688
Prince Roland Bonaparte, Paris, France	1,306
Museum de Histoire Naturelle, Paris, France	1,723
C. F. Baker, Los Baños, Laguna, Luzon	729
College of Agriculture, Los Baños, Luzon	600
Sarawak Museum, Kuching, Sarawak, Borneo	28
Rijks Herbarium, Leiden, Holland	1,425
F. Manson Bailey, Brisbane, Australia	145
National Herbarium, Melbourne, Australia	247

C. G. Lloyd, Cincinnati, Ohio	210
H. Winkler, Breslau, Germany	300
H. Sydow, Berlin, Germany	125
E. J. Butler, Pusa, India	157
T. Petch, Peradeniya, Ceylon	230
Royal Botanic Garden, Edinburgh, Scotland	1,419
T. Kawakami, Taihoku Museum, Taihoku, Formosa	352
Rev. Copland King, Ambasi, Papua	300
H. Yanagawa, Koshun, Formosa	150
Mauritius Botanical Department	178
Forest Research Institute, Dehra Dun, India	244
Carnegie Museum, Pittsburgh, Pa	679
N. Patouillard, Neuilly-sur-Seine, France	97
F. Bubak, Tabor, Bohemia	80
Total	21,255

On special exchanges, in addition to the above, there has been supplied to Dr. H. Sydow, Berlin, Germany, a total of 148 numbers of Philippine fungi, each represented by approximately 60 specimens; that is, about 8,800 specimens, for issue in his "Fungi exotici exsiccati," and to J. Kneucker, Karlsruhe, Germany, 4 species of Cyperaceae, 120 specimens each; that is, 480 specimens, for distribution in his "Glumaceae exsiccatae." In both cases the *exsiccatae* are received by the Bureau in exchange as the fascicles are issued.

In continuation of the botanical and book exchange arranged with T. O. Weigel of Leipzig, discussed in my last report, the following botanical material has been prepared and forwarded:

15 sets centuries XI, XII, Philippine plants	3,000
10 sets flowering plants, 300 specimens each	3,000
10 sets ferns, 60 specimens each	600
6 sets mosses, 100 specimens each	600
6 sets scale mosses, 75 specimens each	450
Total	6,650

For this material we have been credited with a total of ₱1,448 against which the Bureau may order botanical publications and material from the collections advertised for sale by Weigel in his periodical entitled Herbarium.

For all purposes, identifications, exchanges, etc., a total of about 39,200 duplicate botanical specimens have been distributed during the year.

The Bureau of Science is in exchange relations with somewhat over 60 institutions and individuals in various parts of the world, duplicates of Philippine material being exchanged

by this office for material from other tropical countries. During the past year exchanges have been arranged with—

C. G. Lloyd, Cincinnati, Ohio, for fungi.
H. Winkler, Breslau, Germany, for Bornean plants.
H. Sydow, Berlin, Germany, for fungi.
E. J. Butler, Pusa, India, for fungi.
T. Petch, Peradeniya, Ceylon, for fungi.
Royal Botanic Gardens, Edinburgh, Scotland, for Indian and Chinese plants.
Taihoku Museum, Taihoku, Formosa, for Formosan plants.
Copland King, Ambasi, Papua, for New Guinea plants.
H. Yanagawa, Koshun, Formosa, for Formosan plants.
P. König, Mauritius, for Mauritian plants.
R. S. Hole, Forest Research Institute, Dehra Dun, India, for Indian plants.
Carnegie Museum, Pittsburgh, Pa., for tropical American plants.
N. Patouillard, Neuilly-sur-Seine, France, for fungi.
Bureau of Plant Industry, U. S. Department of Agriculture, for fungi.
F. Bubak, Tabor, Bohemia, for fungi.

Exchange propositions are pending with several other individuals and institutions. In the past year exchange material has been sent to 35 different institutions and individuals, and material has been received from 20 different sources.

Publications.—The Philippine Journal of Science, Section C, Botany, for which the section of botany is responsible, has been successfully issued. The papers here published have been prepared by employees of this Bureau or by various other specialists, and are nearly all based on material supplied by the Bureau. A list of the articles published and publications issued during the year is given elsewhere.

In addition to the papers already published, several others are now in press, others are ready to be sent to the printer, and still others are in preparation.

Investigations.—The work of Mr. E. D. Merrill, chief of this section, so far as he is free from duties of botanical instruction in the University of the Philippines, still continues to be largely on questions of taxonomy and geographical distribution of plants. The Philippine collections made during the past year have been so extensive that there is work for several months in sight in properly classifying and distributing the material already prepared. The novelties to be found in these collections will be the basis or partial basis of several papers now in preparation or anticipated. Data recently secured in northern Palawan will be worked up into a paper on the relationship of the *caiñgin* system of agriculture to the various types of vegetation, and especially the great loss to the timber resources of the Islands from this system of clearing the forests and burning the fallen

trees. As opportunity is had, work is being done also on the collections of extra-Philippine plants from Borneo, Guam, and China. The material from the above regions comprises the collections made for the Bureau of Science in Sarawak, Borneo, through the kindness of J. C. Moulton, Esq., of the Sarawak Museum, 1,659 numbers; material from Guam secured by Mr. R. C. McGregor, by Mrs. M. S. Clemens, and through the kindness of Mr. J. B. Thompson of the Guam Experiment Station, 778 numbers; material from the Provinces of Shantung and Chihli, China, collected by Mrs. M. S. Clemens, about 800 numbers; and material from Annam, Indo China, collected by Dr. C. B. Robinson, 555 numbers. The last collection, however, is being named at the Museum d' Histoire Naturelle, Paris, France, to which institution a duplicate set was sent to assist the botanists there in the preparation of a flora of Indo China.

Doctor Robinson has given much time and attention to the collection and identification of botanical material on and near Mount Maquiling, and in this work has the coöperation of the botanists at the College of Agriculture at Los Baños. It is planned eventually to publish the results in the form of a critical enumeration with keys to the families, genera, and species. This work will be of very great value to the botanical department and the students of botany at the College of Agriculture, University of the Philippines, as it will enable one readily to determine the proper names of the plants found in the vicinity of the College. It will also be of great assistance to Doctor Brown of this Bureau, who is carrying on extensive physiological investigations on Mount Maquiling, in correlating his physiological data with the names of the plants found in the different habitats. Doctor Robinson's most important work, however, has been the development of the plans botanically to explore the Island of Amboina in the Molucca group, south of the Philippines, to which he was assigned some months ago. Amboina was early made famous in the annals of natural history by Rumpf, who resided there for many years, and who there wrote his great work entitled Herbarium Amboinense. This publication (1741–55) has been referred to by a great many botanists since the establishment of modern nomenclature, and very many of Rumpf's crude figures have become, by citation, the actual types of a large number of species. In critical groups it has proved to be impossible for later botanists properly to interpret many of these species from an examination of Rumpf's work alone, and no comprehensive botanical exploration of the island has been undertaken since Rumpf's death in 1702. We believe that

the species based on Amboinan material can only be interpreted correctly by the examination of a series of specimens collected in the localities given by Rumpf for his different species in relation to other data given by him, such as habitat, native names, uses, and dates of flowering and fruiting. In as much as the general flora of Amboina is very similar to that of the Philippines, many of our local problems in nomenclature can be solved by determining the exact status of those species based on Rumpf's figures. Attempts made by Stickman, by Linnæus, by Henschel, and by Hasskarl to determine the status of the Rumphian species have been only partly successful because those authors had little or no botanical material from Amboina. It can justly be claimed that this botanical investigation of Amboina is one of the most important pieces of taxonomic research to be prosecuted in the entire Malayan region. The Dutch botanists at Buitenzorg, Java, to whom the plan was submitted, have promised their full coöperation and support. To carry out the plan, Doctor Robinson left Manila on June 17 for Amboina, where he will spend some months in botanical exploration and observation. On his return it is our plan to study the material collected and to issue illustrative sets of Amboinan plants correlated, so far as possible, with those figured and named by Rumpf.

Doctor Brown has continued his observations and studies on the vegetation of Mount Maquiling, especially the relationship of the vegetation to environment, altitude, humidity, rainfall, soil moisture, and other factors. The problem is an exceedingly broad and complicated one, and new phases present themselves from day to day. The amount of instrumentation necessary and the great amount of routine involved keeping the instruments in condition, recording data, and interpreting the results will take practically all of Doctor Brown's time and energy for some months to come. No similar piece of work has been done in the tropics, and, for that matter, at no place in the world on such an extensive scale. The completed observations will form the basis of a series of very interesting and valuable papers on the relationship of different types of tropical vegetation to environment, and certainly demonstrate some facts of great economic importance.

Mr. Graff is prosecuting the work on various phases of Philippine mycology and vegetable pathology, in part identifying both the accumulated and current collections of Philippine fungi, preparing duplicate material for exchange purposes, and working on some problems in plant pathology. He has in hand

a proposed publication on Philippine plant diseases, in which he proposes to describe and discuss the different plant diseases already known from the Philippines with, as far as possible, nontechnical descriptions of the organisms causing the diseases, the characters by which they may be recognized, and methods of prevention and eradication. This work will be a basis for the further study and investigation of vegetable pathology in the Archipelago, a phase of botany that as yet has received but little attention in the Philippines.

Field work.—As in the past, it has been our object to have collections made, so far as possible, in regions not previously botanically explored. One native collector is kept in the field most of the time, while other members of the staff make trips from time to time for the purpose of botanical observation and the collection of material. The most extensive single collection made during the year was by Mr. Merrill at Taytay, Palawan, April 7 to June 7, 1913, of which no definite summary has been included. The collection comprises about 1,100 numbers, represented by about 15,000 specimens. Collections approximating 1,000 numbers were made by Mr. R. C. McGregor in Nueva Vizcaya Province and Ifugao subprovince. Extensive collections also have been made in the Provinces of Laguna, Tayabas, Rizal, and Bataan, Luzon, and in Leyte, Panay, Basilan, and Mindanao. A total of 5,066 specimens, from the collections made by employees of the Bureau of Science, have been incorporated in the herbarium. Miscellaneous collections made by employees of the Bureau of Forestry, chiefly tree species, amount to 1,065 numbers; this material has mostly been received in small lots from many provinces and islands.

ENTOMOLOGICAL SECTION OF THE BIOLOGICAL LABORATORY

Routine work.—Considerable time has been consumed in field investigation and collection of injurious and other insects when called upon either by private individuals or bureaus of the Government and in suggesting methods of combating such common pests as mosquitoes and flies. The routine work further consisted in mounting and accessioning of material and in arranging the same in the collection. The greater part of the collection has been rearranged.

Mr. Banks has spent considerable time in the supervision of the mosquito-extermination project carried out by the Bureau of Health, and has continued to give some instruction in the University. We are handicapped more than ever in the entomo-

logical work by the lack of a suitably trained Filipino assistant who can devote his whole time to the preparation of material.

We have a large amount of unmounted material on hand, and we should keep up with the specimens received. One thousand six hundred thirty new insect boxes ordered for the new wing of the building have been received and provide facilities for storing prepared material.

Accessions.—We have first accessioned rare material and species not represented in our collection. Even taking these facts into consideration, our numbers for the last year begin with 14,408 and end with 17,044, showing an accession of 2,636 lots (2,250 lots in 1912), or approximately 13,180 specimens ready for study.

Donations.—Fr. F. R. Sanchez, S. J., has donated a considerable number of insects collected either by himself or some of his students at various times and places during the year, many very desirable specimens having been taken at Mount Mirador, Baguio, Benguet. Many other individuals have donated single specimens to the collection.

Exchange.—Exchanges of insects have been effected with the following:

G. A. Waterhouse, Sydney, Australia, for Lepidoptera.
Germain Beaulieu, Ottawa, Canada, for Lucanidæ.
M. E. Walsh, Soekaboemi, Java, for Lepidoptera.

Classification and identification of material.—During the year Mr. Schultze has finished the manuscript of a catalogue of the Coleoptera of the Philippine Islands.

J. Weise, K. M. Heller, F. Ohaus, W. Horn, H. Gebien, and M. Bernhauer, eminent entomologists, have served us most zealously, both in the identification of material and in the preparation of papers for publication. The identification work is exceedingly important, as a well identified, systematic collection is the working base for economic problems. Our entomological publications which are mentioned elsewhere give full synonymy and literature references of about 2,200 species, and will be most important as an aid in referring to descriptive literature for the identification of Coleoptera with reference to economic questions.

Silk culture.—Through our efforts, silk culture is steadily increasing in the Philippines. It was introduced into at least one new province during the last year. We have been raising our stock of about 10,000 silkworms per generation. As it becomes necessary after some time to introduce new blood, we imported eggs of the monovoltine Japanese white silkworm from Japan

during the year, with the hope of crossing them with our stock. Unfortunately, most of the Japanese eggs died, probably due to abrupt climatic change. Sooner or later, we shall be obliged to obtain some fresh stock of silkworms of a polyvoltine race from India, for recrossing with our stock. The desirability of a thoroughly competent person to give his entire time to silk culture and its propaganda in the Philippines becomes more apparent each year.

Field work.—In November the sugar-cane leaf hoppers in Los Baños, Laguna, were investigated. A species of the genus *Perkinsiella* had been very abundant in small patches of sugar cane adjacent to the properties of the Calamba Sugar Estate Co., but it was found that a small egg parasite belonging to the genus *Paranagrus* was apparently holding the pest in check. This parasite is similar to a species which has been introduced artificially into Hawaii, and appears to be performing naturally the functions which those who work on sugar-cane insects in Hawaii have been obliged to obtain at much labor and expense.

From April 5 to June 7, 1913, Mr. Schultze was detailed on a biological expedition to Palawan, where a large number of new insects were found.

In April, Mr. Banks was detailed to Aparri, Cagayan, to take charge of the eradication of flies in that place, and subsequently to investigate the cacao pests reported from Ilocos Norte.

At Aparri, it was found that flies, similar in appearance and habits to the common house fly, were breeding under the most unexpected conditions; namely, in the large jars of macerated salt fish, known in that region as *bogoñg*, and extensively exported to various points in Ilocos Norte and Ilocos Sur. Public mass meetings for the enlightenment of the people on this subject were held, and the municipal authorities passed an ordinance compelling the manufacturers of this substance so to close their jars that it would be impossible for flies to have access to the contained material for the purpose of laying their eggs or, in case they had laid them previously, to prevent the escape of those flies or maggots which might develop therein. There has been a decided decrease in the number of flies in the town.

In Ilocos Norte numerous species of insects, hitherto not recorded as coming from cacao, were found on a large plantation established about twenty years ago and practically abandoned until within the past year. Collections of both the insects and the damaged plants were made, and certain material was brought to Manila for further study.

SECTION OF FISHERIES OF THE BIOLOGICAL LABORATORY

The ichthyologist was absent on leave in the United States from July 27, 1912, to January 3, 1913. During this time the helpers of the section of ichthyology were engaged in labeling specimens and transferring them to the permanent containers. The collection is in better shape than it has been for some time.

Economic work.—While in the United States, Mr. Seale visited some large sardine canneries and met the directors of these establishments in an effort to interest them in the establishment of sardine canneries in the Philippines. These directors requested numerous details, especially regarding the species of sardines and anchovies and their abundance, questions which could be easily answered from data derived from the investigations of this Bureau. The Booth Sardine Canning Co. was sufficiently interested to furnish a case of glass containers in which to send them samples of the Philippine sardines and anchovies in the salted state; this has been done. Sooner or later some of the large fish-packing firms will undoubtedly open establishments in the Philippines; this will be of great advantage to Philippine fishermen.

Window shells.—The demand for window shells has steadily increased during the past year, and we have received from Australia, Honolulu, and the United States letters requesting either shells or information regarding shells. The information desired has always been furnished, and requests for shells have been forwarded to Manila dealers. Owing to the increased demand for these shells, it was thought best to take some steps to insure an increased supply for the future. Therefore, a suitable bottom near Malabon was selected, properly marked on a chart, and 1,000 young window shells were transferred from the Kawit beds to this place. The number could be profitably increased to ten thousand or more.

Commercial button shells.—With the opening of the second button factory in Manila, the demand for shells to be used in the manufacturing of buttons increased as shown by the price of the top shell (*Trochus niloticus* L.), which has advanced from ₱8 to ₱20 per picul. This has stimulated the sale of these shells and a tendency to gather young and immature shells. We strongly urge that a law prohibiting the gathering of top shells less than 9 centimeters across the base be passed.

The black lip pearl-shell (*Margaratifera margaratifera* L.), which heretofore had not been gathered in very great quantities, is also now being taken in vast numbers for buttons. As this

is a shallow-water species, the supply will soon be exhausted unless a law is passed to prohibit the gathering of the young. Hundreds of young shells which are too thin to be made into buttons can be seen at the button factories where they are thrown out as useless. If they had been allowed to grow two more years, they would have been valuable.

For the first time in the history of the Islands the "scope" or "ear" pearl-shell (*Avicula micropterus* L.) is being gathered and made into buttons. This shell was considered of no value until Mr. Seale called the attention of the button manufacturers to its utility.

The desirability of taking the control of the pearl beds in the Christian provinces from the municipalities and placing it under the Department of the Interior is strongly urged. These beds should be charted, and an alternate third of them closed each year in order to maintain the pearling industry and allow the shells to mature.

Fish culture.—The black bass in the Baguio and Trinidad ponds have multiplied in a most satisfactory manner, and this season saw the inauguration of the first black-bass fishing in the Islands. According to regulations issued from the Department of the Interior, bass over 25 centimeters in length may be caught by fly fishing provided that all fishes under this length are promptly returned to the water. The fees charged are used to pay wardens. Bass were successfully transferred in December to the spawning ponds at Los Baños, where they are all alive and in fine condition and where they will probably spawn within the next three months.

Two dozen mosquito fish (*Gambusia affinis*) were brought from Honolulu on January 3, 1913. These were placed in an aquarium, in the section of ichthyology, where they have multiplied rapidly. Two hundred have now been planted in the swamps and fish ponds in the vicinity of Manila, and a stock of perhaps 100 still remains on hand. By actual count one of these little fish ate 500 mosquito larvæ in twenty-four hours; therefore, these fish are of direct importance to the public health, and their cultivation is worth our best efforts.

Scientific work.—A paper on the fishes of Hongkong, giving descriptions of several new species, is nearly completed, and a paper, The Edible Mollusks of the Philippines, was issued during the year. The identification of a number of small collections of fishes from various and numerous localities which have been sent in during the past year will be finished within

the next few months. A study and record of the spawning time and the migration and distribution of our principal food fishes are in progress.

Field work.—Several field trips have been made, and interesting collections secured from several localities, including Samai and Kawit in the vicinity of Manila. Considerable information has been obtained with regard to the distribution of the large food and game fishes of the Islands. Information has been given to the governor of Moro Province which it is hoped will lead to the protection and increase of the fisheries products and the improvement of the pearling industry in Moro Province.

In my previous report I have called attention to the fact that, aside from agriculture, the fisheries are of more importance than any other subject to a great number of the people of these Islands. We have at the present time but one trained man in the section of ichthyology, and a portion of his time is required in collecting for the aquarium. We should have at least one more American assistant and three educated Filipino apprentices in order to carry on the work properly.

SECTION OF COLLECTION OF NATURAL HISTORY SPECIMENS OF THE BIOLOGICAL LABORATORY

Because of the presence of a number of temperate region types, the birds of the highlands of northern Luzon are of especial interest. Collections made by the Bureau of Science at Irisan, near Baguio, in 1903 and at Pauai (Haight's) in 1909 contain specimens of nearly all of these highland species known from Luzon.

In 1912 additional specimens of some of these species were collected at Dupax and at Campote, Nueva Vizcaya.

In January, 1913, Mr. McGregor visited Dupax where collections were made in continuation of work of the previous year. The last week of January was spent at Payauan, while twenty days in the month of February were spent in collecting on Polis Mountain, Ifugao subprovince. A study of all these collections will show some interesting points in the local distribution of species.

In April and May, Andres Celestino was detailed to assist Governor-General Forbes in collecting birds in Mountain Province.

A few pieces of taxidermic work were prepared, but no effort is made to secure this kind of work because the taxidermist's time in Manila is very irregular.

No papers were written for publication.

CHEMICAL LABORATORY

This Bureau has continued to coöperate with the University of the Philippines and to give instruction in chemistry. During the last fiscal year Dr. Harry D. Gibbs, chief of the division of organic chemistry and assistant to the director; Mr. Robert R. Williams, Mr. Albert H. Wells, and Mr. J. del Rosario, assistants in the division; and Mr. T. Dar Juan, an assistant in the division of general, inorganic, and physical chemistry, were detailed for part of their time to instruction and administration in the department of chemistry of the University of the Philippines, and Dr. A. P. West, an assistant in the latter division, was detailed to give all of his time to instruction in the university. This assistance has been given to the university at considerable sacrifice of our own work on account of vacancies which existed in our staff of chemists. However, the head of the department of chemistry of the university especially requested the detail of several chemists for half time in order that he might have a greater number of assistants in handling the large classes. Except to enable the university to have a larger number of instructors at a given time, this arrangement is not the best for the Government, for it is easier to secure good instructors than it is to secure chemists capable of meeting the many requirements of this Bureau. The continuity of our work is destroyed by the detail of so many men. Resignations and readjustments in the Bureau of Science have left several vacancies, all of which will be filled as soon as practicable. Three new chemists sailed from San Francisco on June 28, 1913.

Physical research.—During the past year an extensive investigation of the electrical condition of the atmosphere has been begun in the Bureau of Science by the members of the department of physics of the University of the Philippines under the direction of Dr. J. R. Wright. This work is closely related to that recently carried on in the Bureau on tropical sunlight, and has an important bearing on the effect of a tropical climate on both animal and vegetable life.

A complete study of the electrical condition of the atmosphere involves a thorough investigation at different locations and at different altitudes of the following closely related factors:

(*a*) The total ionization of the atmosphere.
(*b*) The radium-emanation content of the atmosphere.
(*c*) The effect of the penetrating radiation from the radioactive products in the atmosphere and the earth's crust on the ionization in closed vessels.
(*d*) The variation of the electrical potential gradient.
(*e*) The absolute value of the intensity of the rays from the sun.

The variation of all of the above factors with the changes in the meteorological conditions is being made the especial point of investigation. Up to the present time simultaneous observations on all the different phases of the problem have never been attempted at any one laboratory, although frequently suggested as necessary.

Observations on the radium-emanation content of the atmosphere have been taken during the last year by two widely different methods. The first method, which is the one best adapted to the purpose, is the absorption of the emanation by charcoal made from the shells of coconuts and the direct comparison of the amount collected with that given off in a given time from a known amount of radium bromide. The other method, which is especially adapted to a study of the hourly variations of the emanation in the air, involves the collection on a negatively charged wire of the radioactive products of the emanation.

The data obtained from observations extending over a period of about sixteen months show that the radium emanation contained in the lower regions of the atmosphere per cubic meter is of the same order of magnitude as that found for Cambridge, England, and slightly greater than that for Montreal, Canada, being equivalent to that which would be in radioactive equilibrium with about 103×10^{-12} grams of radium. Observations by the radioactive deposit method have shown a diurnal variation with a decided minimum in the evening and a maximum in the early morning.

During the months of April and May, observations by the absorption method were taken at Pauai, Benguet subprovince, elevation 2,456 meters (8,060 feet), by Doctor Wright and Mr. Smith, for the purpose of determining the variation of the amount of emanation with altitude. The average amount of emanation per cubic meter was found to be equivalent to that which would be in radioactive equilibrium with about 24×10^{-12} grams of radium, as compared with 103×10^{-12} for Manila.

Work on the other above-mentioned factors entering into the electrification of the atmosphere is now under way, with the especial object in view of determining for a period of at least one year the relation existing between them and the changes in meteorologic conditions.

DIVISION OF GENERAL, INORGANIC, AND PHYSICAL CHEMISTRY

Mr. W. C. Reibling was appointed chief of this division on July 1, 1912. The work of the division has been seriously handicapped during the fiscal year 1913 by shortage of chemists and laboratory assistants. We have lacked the services of two first-class chemists which are provided for in our regular schedule of employees, and have been still further handicapped by the resignations of Messrs. Beyer and Paterno. On the other hand, the work of the chemists who were available suffered from the lack of trained laboratory apprentices, the considerable time required to train new assistants, and the repeated necessity of shifting chemists from one class of work to another.

Mr. Paterno was appointed on December 1, 1912, and it required several months of careful training on the part of Mr. Gana and others to teach him to be a competent water analyst. He resigned on April 15, just about as soon as his services had become of some value. Since then we have been training a civil-service employee, with the hope of obtaining much-needed help in routine analyses. Likewise, considerable time was lost in training Mr. Davis, who was appointed January 25, 1913, and transferred to the Bureau of Customs April 10, 1913. Mr. King, who was employed to occupy the position left vacant by Mr. Davis, has proved to be very capable and energetic. The vacancy left by Mr. Beyer on January 25 was filled about June 1.

ROUTINE WORK

The data in the table give a general idea of the routine done by this division during the last fiscal year, and for the purpose of comparison corresponding figures for the fiscal years 1910, 1911, and 1912 are included.

Nature of material.	Number of samples tested.			
	1910	1911	1912	1913
Rocks and minerals		25	46	12
Soils, fertilizers, cements, and clays	3,342	3,738	8,636	9,617
Metals and alloys	24	46	36	45
Road materials, stone, gravel, sand, and concrete		440	248	130
Water	82	164	146	197
Calorimeter determinations of fuels		29	9	31
Boiler tests of coal		10	2	
Standardizations of weights and measures (sets)		1,066	990	1,127
Coal analyses		154	20	58
Paint				46
Miscellaneous[a]	248		248	91
Total	3,696	5,672	10,381	11,354

[a] Work classified "Miscellaneous" in 1910 is largely segregated in 1911, 1912, and 1913.

All of this routine work was done at the request of officials in various departments of the Government and individuals representing private or corporate interests according to the figures given below.

Department.	1912			1913		
	Free work.	Cash work.	Total.	Free work.	Cash work.	Total.
Bureau of Agriculture	15		15	2		2
Bureau of Audits	1		1			
Bureau of Constabulary		7	7		2	2
Bureau of Customs	34	1	35	10	20	30
Bureau of Education	1		1		4	4
Executive Bureau		5	5			
Bureau of Forestry	3	5	8	2		2
Bureau of Health	40		40	56		56
Bureau of Internal Revenue	3		3			
Bureau of Quarantine Service					2	2
Bureau of Lands	12		12	5		5
Bureau of Navigation	10	30	40	1	3	4
Bureau of Posts	2		2			
Bureau of Prisons		1	1	2		2
Bureau of Public Works	49	2, 246	2, 295	96	3, 932	4, 028
Bureau of Supply	456	6, 224	6, 680	922	5, 664	6, 586
Bureau of Science	93		93	100		100
Weather Bureau	4		4			
City of Manila		179	179		29	29
College of Medicine and Surgery	2		2		180	180
Philippine General Hospital	6	2	8			
Provinces and municipalities		657	657		142	142
United States Army and Navy		71	71		180	180
Nonofficial	221		221			
Total	952	9, 429	10, 381			11, 354

The number of samples of cement submitted for physical testing increased from 7,966 for 1912 to 9,617 for 1913. In addition to this numerical increase, the adoption of the new cement specifications has increased the work involved in the testing of a given number of cements by 50 per cent. The present capacity of the cement-testing laboratory is as great as economical conditions make advisable; but very often, owing to the present system for the purchase of Portland cement, as many as 800 or 900 samples have been submitted for test in two or three days while at other times we received very few samples for weeks. This alternate swamping and stagnation of the cement-testing force is very difficult to meet. The work could not be turned out promptly under such conditions unless we were to keep available at all times a very large force of trained workers, and, if we did

this, a greater part of the force would be idle about half of the time. Our capacity soon will be 65 samples per day, or 16,250 samples per year of 250 work days. This will enable us to turn out about 1,400 tests a month, and it seems that, with a little care and judgment on the part of those most responsible for the purchase and use of Portland cement, the swamping of our force could be avoided. Obviously, we could increase the testing capacity to any desired figure; not, however, without a correspondingly large additional cost to the Government.

While there has not been a corresponding increase in the demand for tests of road materials, the work now done on each sample is much greater than when it was customary to request only an abrasion test. Local engineers now demand a complete examination, including abrasion, hardness, toughness, cementive value, fracture, and classification; and lately they are giving consideration to the chemical and physical properties of tars, asphalts, bitumens, and oils intended for use on local roads.

The Bureau of Science has pointed out the advisability of a more systematic and coöperative study of the efficiency of available road materials under actual conditions of local climate and traffic, but little has been done along this line so far as we know.

It frequently happens that a request for information concerning the composition, value, or utility of a sample involves a lengthy and complicated examination. At other times a correct interpretation of the results obtained cannot be given without much study and considerable research work. Among such requests received during the past year were the following:

1. To state from the results of analyses the relative efficiency of different kinds of prepared bituminous roofing felts.

2. To determine the suitability of 23 different raw materials for the manufacture of Portland cement. This involves a great amount of work as it is necessary not only to analyze each material, burn the most promising mixtures obtainable from the same, and subject the final product to routine test, but also to study the effects of different degrees of liming, burning, seasoning, and plastering.

3. To determine from the results of analyses the relative efficiency of different kinds of paints and protective coatings, taking into consideration the local conditions such as are met with according to whether the material is subjected to the action of sea water, fresh water, or air.

4. To ascertain a practical method for bleaching low-grade hemp fibers and rope, Malacca cane, etc.

5. To determine the cause of foreign deposits in the product of a local artificial ice plant.

6. To solve problems connected with the creosoting of local timber.

7. To determine the cause of the rapid corrosion of certain kinds of iron and other metallic structural materials.

8. To determine the value of clays and shales for ceramic purposes.

9. To determine the composition or formula of such manufactured products as electric batteries, paints, waterproofing compounds, etc.

10. To determine the apparent and relative value of different kinds of road materials, including clays, crushed stones, gravels, asphalts, oils, and bitumens.

11. To endeavor to find the cause of certain epidemics from waters which apparently are potable.

12. To determine the cause of failure in materials of construction.

13. To classify different samples of Babbitt metals and lubricants in their true order of merit.

14. To test and analyze the 19 different kinds of roofing materials submitted in a recent contest for a substitute for nipa roofing and report on their relative efficiency. In most instances it was necessary to devise special methods of analysis in order to prove the correctness of the formulas submitted by the contestants.

The large amount of work accomplished by this division, handicapped as it has been by such unavoidable conditions, is, in itself, sufficient proof of the diligence and ability of Messrs. Beyer, Gana, Dar Juan, Reyes, King, and Arguelles who at all times did the work assigned to them in a very satisfactory and painstaking manner and often worked overtime and on holidays in order to keep up with the work.

RESEARCH WORK

The published research is included under the heading The Philippine Journal of Science and other publications.

Under my direction the study of the oxidation of coal, Philippine soils, and the local manufacture of salt has been continued.

Considerable work has been done by myself, Mr. W. C. Reibling, chief of this division, and Mr. V. Q. Gana on a paper dealing with the water supplies of the Philippine Islands. The completed publication will involve a great amount of work, only about half of which has been done. The paper should be finished as soon as possible, especially on account of the many important considerations included.

The subject of corrosion and protective coatings is a very important one, and the necessity of a thorough investigation along these lines is becoming more and more essential. Thousands of dollars have been wasted through the rapid deterioration of metallic structural materials and protective coatings. Many of these apparently give very satisfactory services in other parts of the world, but they deteriorate very rapidly here where the climatic conditions are so different. We have segregated important references to the literature of the subject and sent

numerous requests to manufacturers for samples of paint, pigments, and oils, to which they have responded very heartily, and some of them have contributed valuable information. They are looking forward with considerable interest to our results. On the other hand, we receive numerous requests for information on the same subject from the users of such materials. Eventually, we hope to investigate the value of local vegetable oils, gums, and resins as raw materials for protective coatings. Paint consumers and manufacturers have sought for a vehicle which will be less easily saponified by alkalies or oxidized by the atmosphere after drying, and perhaps the vegetable life of this country will furnish a more resistant product than any at present known.

The special committee appointed by Executive Order No. 32 (1913) has requested a special appropriation to carry on research work here for the primary purpose of investigating the efficiency of various kinds of galvanized iron. It is hoped that means will be supplied to carry the investigation at least far enough to enable us to purchase all materials of construction according to specified requirements which will guarantee satisfactory service. The specifications adopted by other countries cannot be relied upon to give satisfaction here for reasons already mentioned.

Six or seven months ago samples of galvanized iron from buildings in the provinces were secured which were in excellent condition after many years of service. Others were badly corroded, although they had been exposed for a few years only. We had hoped to complete a thorough study of these samples and ascertain the cause of their relative value. This work will be done as soon as time will permit.

Work on the expansion of Portland cement mortars under different conditions of exposure and two important problems involved in the manufacture of sand-lime brick and natural cement, begun some time ago, have been practically at a standstill owing to routine work.

More than a year ago, at the suggestion of Doctor Freer, the chief of this division began very important studies on the chemical and physical properties of fused cement mixtures. He has built a satisfactory furnace, and the results obtained from the preliminary burnings indicated that this line of work possessed possibilities of great scientific and commercial importance. This work demands his personal attention, much of which he has had to give to other things.

It has been the constant endeavor of cement manufacturers and users to develop a quick and reliable test for Portland cement, and recent experiments with the autoclave test indicate a possible solution of the problem. However, the autoclave test cannot become of value until the significance of the results obtained are thoroughly understood. A thorough study of this test has been begun, but the investigation has only reached the preliminary stage.

Samples of soft rock from Nueva Ecija submitted by the Bureau of Public Works for valuation as a road material proved to be hardened clay which apparently possessed many of the properties of a material suitable for the manufacture of vitrified brick. A few trial mixtures gave very promising results as well as evidence that the clay would have to undergo special treatment for use in paving brick. Owing largely to the energy of Mr. King, who worked on the problem outside of the regular working hours throughout the hot season, we have obtained very satisfactory products.

Our investigation of raw materials to determine their suitability for the manufacture of lime; hydraulic, Roman, and Portland cement; and sand-lime brick has been continued, and materials which proved satisfactory will be subjected to the conditions of actual manufacture in a new lime kiln of 500 pounds' capacity, which we have just completed.

A large number of problems of industrial and economic importance await time and opportunity to investigate them.

DIVISION OF ORGANIC CHEMISTRY

Personnel.—Dr. Harry D. Gibbs, chief of the division of organic chemistry and assistant to the director, has been absent on leave since the beginning of the calendar year, and the work of the division has been under the direct supervision of Mr. R. R. Williams and Dr. D. S. Pratt. Mr. Williams resigned on June 15, to go into commercial work in Manila, and Mr. J. del Rosario and Mr. E. R. Dovey resigned on September 30, 1912, and June 1, 1913, respectively. Mr. Williams will continue to devote a portion of his time to research work in the Bureau.

ROUTINE WORK

The routine work alone of the division has been of as wide a variety as in previous years, and has practically consumed the time of three chemists and a part of that of others. Aside from two classes of samples mentioned below, this work has shown

a material increase, and the actual work involved is as great as that performed during any year since the organization of the Bureau.

Nature of sample.	Number.				Total.
	Examined under Act 1655.	Adulterated or misbranded.	Government work (not included under Act 1655).	Private work.	
Meats	57	1	1	1	59
Fish	75	2	1	1	77
Dairy products	71	20	152	28	251
Vegetables	39	8	2	3	44
Farinaceous products	37	7	26	9	72
Vegetable beverages	76	20	3	4	83
Sugar	72	1	1	76	149
Candies	30	14			30
Fruits	26	6	8	3	37
Condiments	47	5	2		49
Cattle feeds			21	1	22
Copra				6	6
Paper and textiles			133	3	136
Oils		1	39	2	41
Soaps			4	5	9
Paints			22	9	31
Miscellaneous	1		15	18	34
Opium	1	1	84	1	86
Essences	29	4	5	29	63
Nonalcoholic beverages	45	17			45
Alcoholic beverages	18	6	18	6	42
Food colors	16	1	1	3	20
Drugs	45	21	23	5	73
Medical	12	1	216	22	250
Sugar cane			18	22	40
Total	697	136	795	257	1,739

In all, 1,739 samples have been examined, distributed as shown in the above table. The total number of samples has decreased from 1,921 last year, or 8.9 per cent. This decrease is confined to two classes of samples; namely, raw sugar and urine (medical analyses). These analyses are very simple and quickly performed, and do not reduce the work of the division in proportion to the number. Raw sugar samples have decreased on account of the large proportion of low-grade sugar produced this year. In the commercial grading of sugars the distinctions between the low grades are much less finely drawn than in the case of the high grades, and polarizations are usually unnecessary. Most of the routine examinations of urines have been transferred to another branch of the Bureau. Pending a satisfactory settle-

ment of a standard for carabaos' milk and a further investigation of the local conditions of infant feeding, the health authorities have ceased to submit any large number of fresh milks. In the above numbers are included 124 samples of carabaos' milk which this Bureau has collected and analyzed in order to furnish data for the much-needed standard and to supply information which will improve this important native food product, especially for invalids and infants.

The number of samples examined under Act 1655 was 697 as compared with 637 last year. The number adulterated was 136 as compared with 171 for last year. The Foods and Drugs Act has been more strictly enforced, especially with reference to products of local origin than has been possible previously. The first legal prosecutions have been made this year under Act 1655. Sixteen prosecutions have been instituted, with a result of 10 convictions and 6 cases pending. The enforcement of the law with regard to imported products has been satisfactorily rigid for some years. However, its enforcement with respect to domestic products is believed to be of much greater import to the health of the native population.

The amount of Government work, that is, work performed for all branches of the Philippine and Federal Governments, exclusive of that done under Act 1655, is increasing as is that done for private parties. Nearly all the work of the division is rush work. For example, all imported samples examined under Act 1655 are held at the Custom House pending the result of analysis, and the work must be done promptly. All perishable samples must be treated in the same way. Paper and certain samples of distilled liquors are the only important exceptions. Work which does not need to be completed immediately is used to fill in short leisure periods which are valueless for research work, especially since one can never be certain when such leisure periods are going to occur. The plan, which is now in use and has proved satisfactory in the medical section of the biological laboratory, of assigning certain men for research work and others for routine, is being considered with reference to this division. Under this system two or three men could carry the burden of all routine work except perhaps an occasional sample of unusual character. It requires men of considerable ability and, above all, experience to carry on the diversified routine work of this Bureau, and this experience is not the same that fits a worker for special research. It may be that this plan will result in a great economy to the Bureau.

RESEARCH AND INVESTIGATION

The volume of the research contributed by this division during the year is indicated by the fact that 14 articles have been prepared for publication, 1 is in preparation, and work is in progress on 4 other problems. The authors and titles of the published articles are given under the heading The Philippine Journal of Science and other publications.

I desire especially to mention the work done on the nipa palm as a source of sugar. This arose from an experiment on a large scale, the results of which have led to investment in an enterprise to utilize the nipa swamps of the Islands much more effectively. This may well be expected to lead to large results in the industrial development of the Islands.

There is need for continuation of the investigations of copra, but we have not been able to do this during the past year. This work should be taken up again and carried out thoroughly with the object of devising and putting into general use an inexpensive but effective kiln for drying copra. A quick commercial method for grading copra should also be devised, and efforts be made to induce local copra merchants to do their buying on a more scientific basis. The data as yet collected on this subject are fragmentary and useless until supplemented by further work, especially in the field.

The report of the Iloilo sugar laboratory is made separately on page 107.

DIVISION OF MINES

Personnel.—Dr. Warren D. Smith, chief of this division, returned on October 2, 1912, from leave in the United States where he had been investigating the most important oil fields in California. He studied the situation from the points of view of the geological features and the methods of the geologists; drilling operations; pumping methods; the distribution of the product, including storage and marketing; refining; the leasing system; and legislation. This investigation will increase the reliability of the judgment of the geologists of this Bureau with regard to the practical side of our study of the Philippine oil fields. Mr. Percy D. Kincaid was appointed a temporary employee on August 25, 1912. Mr. F. T. Eddingfield went on leave on November 25, 1912, and returned June 5, 1913. Mr. F. A. Dalburg has been on leave since May 7, 1913. Mr. P. R. Fanning left Manila on June 15, 1913, to spend his leave in the United States. He will attend the Congrès Géologique Internationale in Toronto as a delegate from the Philippines.

ROUTINE WORK

During the year 242 assays for private parties, including 2 free assays for prospectors in new districts, and 439 assays on research work, besides 19 bullion assays were made. This shows a slight increase over the number of assays made during the previous year, which is surprising when one considers that installations of assay offices at the Colorado mine, Masbate, and the Headwaters mine, Benguet, have been made, and also that a number of quartz prospectors have transferred their attention to placer deposits. At the present time, owing to the small number of assays received, this Bureau is carrying on the work at an actual loss of ₱0.88 each. However, this seems warranted when one considers the great service to prospectors and engineers in enabling them to obtain accurate and reliable results.

As heretofore, there has been a continued demand for the services of the geologists to make field investigations on geological or engineering problems of strictly economic value. All of the investigations undertaken for private parties have been carried on in order to discover the economic possibilities of various deposits and thereby to aid in advancing the mining industry.

Geological reconnaissance work has been carried on in various parts of the Archipelago. The geologists have not visited so many places as formerly, but the work has been carried on in a more intensive manner. Three large relief maps of the Philippine Islands, the stone work for 2 medium-sized lithograph maps in three colors, 12 original maps, 21 tracings in ink, as well as a number of free-hand drawings, arrangement of illustrations, etc., have been made by the artists.

INVESTIGATIONS

The Mineral Resources of the Philippine Islands for 1912 is nearly ready for the press. It will contain the following articles:

Review of the year, by Warren D. Smith.
Statistics of production, by F. A. Dalburg.
Status of mining claims, by F. A. Dalburg.

THE METALS

GOLD:
- The Paracale district, by Paul R. Fanning.
- The Aroroy district, by Percy D. Kincaid.
- The Baguio district, by Warren D. Smith.
- Other districts, by Frank T. Eddingfield.

IRON:
- The Angat district, by F. A. Dalburg.

Other metals, by F. T. Eddingfield.

THE NONMETALS

The production of nonmetals in 1912, by Wallace E. Pratt.
General features of coal mining in 1912, by F. A. Dalburg.

SPECIAL ARTICLES

Petroleum on Bondoc Peninsula, Tayabas, by Wallace E. Pratt and Warren D. Smith.
Sand-lime brick and artificial sandstones in the Philippines, by Alvin J. Cox, W. C. Reibling, and F. D. Reyes.
Contribution to the metallogeny of the Philippines, by Paul R. Fanning.

The details of papers which have been prepared and published in The Philippine Journal of Science will be found in another place under that head, but especial attention may be directed to the following research completed during the year:

Ore-testing investigations.—Many important laboratory tests looking to the most efficient treatment of Philippine gold ores have been carried on. Tests have been made on samples sent in from three properties in Masbate, samples from the Paracale dredges, and from Benguet. This work has been supplemented by extended operations at the mills and on the dredges, and the operation of one mill was studied for one month with the result that it was shown where considerable savings and improvements could be made.

Tayabas oil fields.—The most complete survey ever made of any of the prospective oil fields in the Philippines has been completed in Tayabas Province.

Natural gas.—A well, reported to be emitting large volumes of natural gas at Oas, Albay Province, was examined. The public interest was so great that the matter was looked into in spite of our anticipation that it was a pocket of swamp gas, which proved to be true.

New reservoir site for the city of Manila.—A very careful and important examination of a proposed reservoir site for the city of Manila near Mariquina has been made. This work involved questions of seepage, supports for an earth-fill dam, and material for such dam. The results are greatly appreciated by the waterworks engineers, and demonstrate the value of careful geologic investigation with reference to engineering projects.

Geologic and topographic work in Mindoro.—Geologic and topographic notes to be incorporated in the main report of a medical survey of the San José estate in Mindoro have been made.

Palawan.—A second geologic exploration trip to Palawan fur-

nished some interesting rock specimens. A small lake possibly never before visited by white men was explored and mapped.

The Cebu typhoon.—Investigations of the destructive tidal wave in Cebu in October have shown that the Osmeña dam site suffered considerably in the place where a geologist of this Bureau had previously pointed out a probable weakness.

Water resources of Panay.—Doctor Smith spent three weeks in Panay investigating the ground-water resources of a portion of Iloilo Province. He was able to arrive at the following definite conclusions:

1. The sedimentary formations could not be feasibly tapped to produce a sufficient supply of potable water.
2. The buried gravels of the Iloilo delta showed favorable possibilities in this direction.
3. The gas and salt-water well at Janiuay is an indication of the possibilities for a petroleum supply somewhere in that region.

Material was secured on this trip to make a contribution to the geology and physiography of that none too well-known island.

Ore deposits.—A number of experiments on the principles controlling the deposition of gold in quartz-calcite-manganese veins and important contributions to the metallogeny of the Philippines have been made.

Geologic work.—More or less interrupted investigations in various regions have given data on Philippine stratigraphy, which have led to a revision of the table of the sequence of Philippine formations, and other information which will be used in future monographs and other publications.

DIVISION OF ETHNOLOGY

There has been no change in the personnel of this division during the year. Since the disastrous fire which occurred in the vicinity of the museum on Calle Juan Luna in November, 1911, only new buildings of concrete have been built, so that the museum is in no great danger from fire from the rear or south end. At my request, the Bureau of Public Works has recently finished a fire wall at the north end of the museum where the building joins property occupied by Chinese. This wall was built on top of the old stone wall one story in height, extends 1 meter above the roof, and makes the museum as safe from fire as it can be in its present location. When the museum was disarranged with building operations and the laborers were at hand, the storeroom and the smaller office, which formerly

almost divided the museum into 3 small exhibit spaces, were removed to the extreme northern end of the building. On the eastern side of the second floor we now have one long room uninterrupted by partitions. The partition around the stairway, which was formerly over 2 meters high, has been cut down to the height of a hand rail. These changes make the museum lighter, and give the appearance of more space. There has been a large number of visitors this year, especially during the afternoons of the summer season when the museum was kept open and was visited by many people who formerly had found the hours inconvenient.

The investigation of the Ilocano people, begun the year before last, was continued, except for two short interruptions, by field study until May 16, 1913. With the possible exception of one short journey, which may be necessary, the field work is completed. The office work upon the report will now proceed without interruption.

Work on the general ethnology of the Ifugaos has progressed steadily. The finished report will consist of several parts. The first of these, that on the grammar of the Ifugao language, is completed; three other parts are almost finished, and much work has been done on the remainder. It is expected that the entire report will be ready for the printer some time during this calendar year.

A Bontoc vocabulary, prepared by Miss Margaret P. Waterman of Bontoc, and a manuscript by Lieut. Charles W. Elliott on the Lanao Moro dialect, submitted to the Bureau of Science, have been prepared for the printer, and are ready for publication.

Mr. Garvan spent over two months in Tayabas studying the Negritos and Dumagats of that region. Among much valuable information which be gathered was a vocabulary from the Negritos. He has since visited the Negritos of Bataan Province and gathered a vocabulary from them. The report on the Manobos of the Agusan Valley is finished, and has been submitted for publication.

In December Doctor Miller went to Iloilo to investigate reports of interesting caves in Iloilo, Capiz, and Negros Provinces. In one cave in Capiz he found a coffin, well preserved but empty, which was sent to Manila. In no other caves did he find any relic of interest. The reports which had come to us about manuscripts having been found in certain caves of Negros could not be substantiated.

We have added 557 new specimens to the museum collections during the year distributed as follows:

Ilocano (5446–9, 5464–5501, 5849–6054, 6101–7, 6140–1, 6204, 6250–6346)	355
Bontoc (5712–5848)	37
Australian sponges (6147–6203)	57
Australian stone implements (6349–6360)	12
Negritos (6362–6398)	37
From various sources (5045, 6055–6100, 6205, 6242–9, 6347–8, 6361)	59
Total	557

In addition to the above, the following numbers have been added to the museum catalogue by assigning numbers to specimens previously on hand but included as duplicates under other numbers: 5501–5711, 6108–6139, 6142–6, 6206–6228.

The most important addition has been the Ilocano collection. This collection is valuable in itself, and especially because it marks the beginning of exhibits from the Christian people of the Philippines.

The first collections placed in the museum were those returned from the St. Louis Exposition. They consisted almost entirely of specimens from the non-Christian people of the Islands. For several years after the opening of the museum, field work was carried on among the non-Christians only; for this reason, we were unable to obtain collections illustrating the life of the Christian people. At the same time that the study of the Ilocano people was undertaken, a collection from them was begun for the museum. This collection is now practically completed. As soon as the report on the Ilocanos has been finished, we hope to undertake an investigation and obtain similar collections among some of the other Christian peoples.

We have made the beginning of a collection to illustrate methods of transportation on land and water in different parts of the Islands. Models illustrating land transportation are being made uniformly one-half size. There is such a wide range in the size of boats used on the ocean and on rivers that it has been found impracticable to adopt a uniform scale in illustrating water transportation. We have a few boats of full size and a few made on a reduced scale. Until a large museum building is available in which large boats can be exhibited, it will be necessary to follow this plan. This transportation exhibit when complete will be very interesting and will show what a wide variety of means of transportation is in use in the Islands.

LIBRARY

During no year in the history of the Bureau has more progress been made in the permanent organization of the library and in improving methods of routine work. A number of favorable conditions have contributed to this result. The new quarters have given us room to shelve books promptly. The stacks are well lighted and easy of access from the charging desk. The arrangement of the stacks in relation to the charging desk has made it possible for the assistant responsible for the charging desk to do other work when not actively engaged in charging and discharging books or in recording charging records. No changes in the civil service personnel have occurred, and few apprentices have resigned, thus giving a better trained staff than in any previous year. No long absences have occurred either from illness or from employees taking accrued leave. The possession of an excellent union catalogue for reference and comparison has reduced the time spent in reference work, and has been extremely valuable for comparison in classification and in the assignment of subject headings.

The hours during which the library is open are from 7.30 a. m. to 9.30 p. m. from Monday to Friday, 7.30 a. m. to 5 p. m. on Saturday, and 9 a. m. to 12 m. Sunday and holidays. This has been in effect since December 1, 1912, with no change during the summer season. The number of visitors during the late afternoon and evening hours has not been large, but for the most part they have been serious workers, many of whom could come at no other time of the day.

Orders.—Orders for books estimated to cost ₱24,129.13 have been placed during the year, and of these, publications amounting in value to ₱9,458.27 have been delivered, leaving ₱14,670.86 worth undelivered. In addition to these, orders placed during preceding years have been delivered in the amount of ₱3,692.11.

Accessions.—The number of bound volumes accessioned was 3,852; 1,690 by binding and 2,162 from other sources. The total number of bound volumes in the library on June 30 is 26,652. Among the most important works received during the year are the following:

NEW PUBLICATIONS

Adams. The zoölogy of the voyage of H. M. S. Samarang; under the command of Captain Sir Ed. Belcher . . . during the years 1843–1846 . . . Crustacea, 1848.

Agassiz. Bibliographia zoölogiae et geologiae. A general catalogue of all books, tracts, and memoirs on zoölogy and geology, 4 vols., 1848–1854.

American association for the study and prevention of infant mortality. Transactions, 2 vols., 1910–1911.

Beccari. Nelle foreste di Borneo, 1902.
Beechey. The zoölogy of Beechey's voyage to the Pacific in H. M. S. Blossom, 1839.
Bleeker. Atlas ichthyologique des Indes orientales néerlandaises, 8 vols., 1862–1878.
The Bradley bibliography. A guide to the literature of woody plants, 2 vols., 1911–1912.
Bronn's Klassen und Ordnungen des Thierreichs, 27 vols., 1880–1911.
Burmeister. Handbuch der Entomologie, 7 vols., 1832–1855.
Costigan. Handbook on American mining law, 1908.
Darbishire. Breeding and the Mendelian discovery, 2d ed., 1912.
Distant and Champion. Biologia centrali-americana. Insecta. Rhynchota. Hemiptera-Heteroptera, 2 vols., 1880–1901.
Duperrey. Voyage autour du monde, 3 vols., 1826–1830.
Encyclopedia Britannica, 11th ed., 29 vols., 1910–1911.
Gardiner. Fauna and geography of Maldive and Laccadive archipelagoes, 2 vols., 1901–1906.
Gomes. Seventeen years among the Sea Dyaks of Borneo, 1911.
Guppy. Observations of a naturalist in the Pacific, 2 vols., 1903–1906.
Imperial cancer research fund. Scientific reports on the investigations of the Imperial cancer research fund, 5 vols., 1904–1912.
Kayser. Handbuch der Spectroskopie, 6 vols., 1900–1912.
Lamarck. Histoire naturelle des animaux sans vertébres, 7 vols., 1815–1822.
Latreille. Histoire naturelle, générales et particulière des crustacés, 14 vols., 1802–1805.
Milne-Edwards. Expeditions scientifiques du Travailleur et du Talisman, 8 vols., 1888–1906.
The mining magazine, 3 vols., 1910–1911 (1 vol. lacking).
Notes from the Leyden Museum, 35 vols., 1879–1912.
Novara Expedition. Crustacea, Mollusca and Anneliden.
Oken. Allgemeine Naturgeschichte für Allestände, 15 vols.
Progressus rei botanicae, 3 vols., 1907–1912.
Résultats des campagnes scientifiques accomplies sur son yacht par Albert I, Prince Souverain de Monaco, 40 vols., 1889–1912.
Sajous. Annual of the universal medical sciences, 45 vols., 1888–1896.
Saville-Kent. The great barrier reef of Australia, 1893.
Science abstracts. Physics and electrical engineering, 23 vols., 1898–1913.
Seligmann. The Melanesians of British New Guinea, 1910.
Shamel. Mining, mineral and geological law, 1907.
Siboga-expeditie. Résultats des explorations zoologiques, botaniques, oceanographiques et géologiques, entreprises aux Indes Néerlandaises Orientales en 1899–1900 à bord du Siboga, 63 vols.
Société zoologique de France:
  Bulletin, 36 vols., 1876–1911.
  Memoirs, 24 vols., 1888–1911.
Veth. Midden-Sumatra, 8 vols., 1881–1892.
Volz. Nord-Sumatra; Bericht über eine im Auftrage der Humboldt-Stiftung der königlich preussischen Akademie der Wissenschaften · z. Berlin in den Jahren 1904–1906 ausgeführte Forschungsreise, 2 vols., 1909–1912.
Weber. Zoologische Ergebnisse einer Reise in Niederländisch Ost-Indien, 4 vols., 1890–1907.
Wood's Library of standard medical authors, 100 vols., 1882–1887.

Ziemssen. Cyclopedia of the practice of medicine, 16 vols., 1874–1877.
Zoologica: Abhandlungen aus dem Gesamtgebiete dei Zoologie, 25 vols., 1888–1911.

SETS COMPLETED

Albrecht von Graefe's Archiv für Ophthalmologie, 72 vols., 1854–1902.
Annales des sciences naturelles, 182 vols., 1824–1904 (8 vols. lacking).
Annales mycologici, 3 vols., 1903–1905.
Annals of surgery, 22 vols. 1891–1911.
L'Anthropologie, 18 vols., 1890–1903.
Archiv für Kinderheilkunde, 45 vols., 1880–1907.
Archives d'anatomie miscroscopique, 5 vols., 1897–1903.
Chemiker-zeitung and supplement, 74 vols., 1878–1905.
Deutsche tierärztliche Wochenschrift, 10 vols., 1893–1902.
Dutch East Indies. Jaarboek, 4 vols., 1904–1905, 1907–1908.
Folia haematologica, 4 vols., 1904–1907 (1 vol. lacking).
Fortschritte der Chemie, Physik, und physikalischen Chemie, 4 vols., 1909–1911.
Frankfurter Zeitschrift für Pathologie, 8 vols., 1907–1911.
Gegenbaurs morphologisches Jahrbuch, 38 vols., 1876–1908.
Journal de physique, theorétique et appliqués, 40 vols., 1872–1911.
Journal of cutaneous disease, 15 vols., 1888–1902.
Journal of physical chemistry, 10 vols., 1898–1907 (1 vol. lacking).
Liverpool marine biology committee. Memoirs. 17 vols., 1899–1908.
Medical record, 29 vols., 1886–1900.
Naples. Zoological station. Mittheilungen, 18 vols., 1879–1908.
Novitates zoologicae, 14 vols., 1894–1908.
Physical review, 29 vols., 1893–1909.
Semaine médicale, 16 vols., 1882–1893, 1899–1902.
Das Tierreich, 29 vols., 1897–1911.
Wiener medizinische Wochenschrift, 2 vols., 1851–1852.
Zeitschrift für wissenschaftliche Zoologie, 78 vols., 1849–1898.
Zentralblatt für Chirurgie, 35 vols., 1974–1908.
Zentralblatt für die gesamte Physiologie und Pathologie des Stoffwechsels, 9 vols., 1900–1908.
Zentralblatt für Physiologie, 24 vols., 1887–1910.
Zoologische Jahrbücher, 58 vols., 1886–1908 (2 vols. lacking).

Binding.—Eight hundred forty-nine volumes were at the bindery on July 1, 1912; 1,500 volumes have been sent since, and 1,529 returned, leaving 820 volumes still undelivered.

Classification.—All new material has been classified promptly as received and the old material of a miscellaneous character somewhat reduced. There is very little unclassified scientific material remaining, although some of the publications will be valuable as reference material when made available. All catalogues of universities, colleges, medical colleges, and technical schools have been included under the regular classification schemes and placed on the shelves according to regular Library of Congress class numbers. The better trained Filipino assistants are showing great interest in the subject of classification,

and are becoming very helpful in this branch of library work. It is hoped that all material in the library eventually may be classified according to one classification system, so that cards representing the entire content of the library may be included in one shelf list. College catalogues are already so included, the work on trade catalogues has been begun, and a scheme has been worked out to apply to maps, charts, and blue prints.

Cataloguing.—A typewritten list of author headings for government documents, based, for the most part, on Library of Congress usage, has been prepared by the assistant librarian. Subject headings have been unified, and a large number, including all used to date, filed in alphabetical order, with the authority for the form adopted. Here also Library of Congress usage predominates. Subject work has been completed for all new material as received and for all publications returned from the bindery. In addition, classes A–J inclusive have been entirely completed.

The following table shows the technical work performed:

Nature of material.	Classification and cataloguing (new material).	Reclassification and assignment of subject heading (old material).
Books:		
Bound volumes	3,743	634
Unbound volumes	3,391	292
Parts	2,079	151
Total	9,213	1,077
Cards:		
Shelf list	1,136	194
Main catalogue	4,071	1,307
Total	5,207	1,501

Printed cards.—The extension in the use of Library of Congress printed cards by the different libraries will more and more tend to bring about uniformity in all matters in which they differ. After a careful test of the cost of typewritten cards in comparison with that of printed cards, the result was so overwhelmingly in favor of the latter, that an order was placed for ₱1,500 worth of Library of Congress printed cards. This first order included cards for serial publications only, the individual numbers of which are separate monographs; for example, U. S. Geological Survey, professional papers, the separate bulletins of the U. S. Bureau of Chemistry, and the different papers included

in the Siboga Expedition, and covered nothing not already in the library or ordered. I desire to order all available printed cards for publications in series and the cards, printed by the Royal Library at Berlin, for inaugural dissertations as soon as funds are available. It is probable, that by securing cards from various sources a large proportion of all our serials may be analyzed in the near future.

Union catalogue.—The largest single piece of work accomplished during the year is the completion of the filing of the union catalogue, consisting of one copy of the author card for each title. This catalogue consists of Library of Congress printed cards, Library of Congress proof, cards printed by the John Crerar library during one year, and those printed by the American Library Association for two series. This catalogue now occupies 196 card cabinet and sorting trays, and contains approximately 325,000 cards.

Photographs.—To give more adequate protection against fire, the collection of photographic negatives, now amounting to 16,200 five by seven, and 1,250 eight by ten, negatives, has been moved into the library and placed in an accessible place on the second floor.

Cuts.—The Bureau of Science collection of cuts, numbering approximately 3,800, has been carefully identified by comparison with the prints and numbered with steel dies in such a way that this record cannot be lost. Copies of the prints have been pasted into an album, each print receiving the same number as the cut, and, in the case of The Philippine Journal of Science, the number has been placed on the margin of the print in the bound set reserved for use in the library. They are now available when needed, although the work is not completed.

Reserve stock of The Philippine Journal of Science.—To protect against loss by fire, 36 complete sets of The Philippine Journal of Science have been placed in the library as a reserve stock.

Duplicates.—A large number of duplicates, many of which may be used to good advantage as exchange material, still remains on the shelves. "Want lists" and "duplicate lists" received are always examined carefully, and all duplicate material on hand and not needed is forwarded whenever there is opportunity. By this method, we have frequently filled in our own sets, receiving numbers lacking from our files in return for duplicates sent.

Exchanges and gifts.—A number of exchanges for the publications of the Bureau have been arranged, adding several valuable

publications; and several reports of commissions, series of government publications, etc. have been secured without cost.

Circulation.—The circulation of the library has increased steadily. All bound volumes out of the library were recharged once during the year, and single numbers of serials were checked three times. Calling in numbers to complete volumes for binding serves as a check against loss of single numbers, but it would be more satisfactory if the staff were sufficiently large to enable us to call in single numbers for renewal or discharge monthly and bound volumes at least twice a year. The total number of volumes charged during the year was 20,264, an average of 55.5 per day, including holidays and Sundays. The average per day for the fiscal year 1912 was 23. The total number of books out of the library on June 30, 1913, was 5,600. Many of these have been charged out since September, 1912, the time at which the recharging of all books out of the library was completed. No time limit has been placed on the circulation, and many of the above volumes are kept out practically all the time as deposits.

Use.—The use of the library has increased since the extension of the hours during which it is open and with more general information as to its resources. The recently completed installation of the lights in the stacks facilitates our work, and we are in a position to give a greater degree of publicity in regard to the library than we have heretofore found possible. There should be much greater growth during the next year. The tables will accommodate comfortably from twenty-five to thirty readers, and there is space in the reading room for another table to accommodate ten or twelve.

ENGINEERING DIVISION

There have been no changes in the direct supervision of the power plant or the responsible employees during the year, Mr. José Guerrero y Reyes remaining as chief engineer and Mr. F. R. Ycasiano as assistant engineer. Many of the subordinate employees have resigned and have been replaced by others.

The extension of the boiler room in front of the furnaces made possible the elongation of the fire box of, or more exactly the addition of a Dutch-oven furnace to, the new boiler and a convenient arrangement of auxiliary machinery and pumps in front of the boiler room, where there is good light, less dust, and better ventilation, conditions that help to reduce the depreciation of machinery.

Power plant.—This is the central power plant for the Philip-

pine General Hospital, the Bureau of Science, and the College of Medicine and Surgery, and supplies these institutions with electric current for operating incandescent and arc—including stereopticon—lights; fans; refrigerating machines for the city morgue, for the serum products, ice manufacture, and other purposes of the Bureau of Science, and for the food products of the Philippine General Hospital; air compressors; vacuum pumps; motors for driving the air and water ventilating and circulating systems, ore crushers, pulverizers and grinders, water pumps, gas scrubbers, centrifuges, and road materials testing apparatus; electric elevators; x-ray apparatus; radiographic apparatus; pantostat; cauterizers; radiometer; keratometer; ozonizers; electric furnaces and incubators; ultra-violet light sterilizing apparatus; liquid-air machine; electric enunciators; induction coils; ultra-violet photomicrographical apparatus; and charging electric ambulances, automobiles, storage batteries, etc.: steam for operating steam tables, urns, boilers and kettles, hot air baths, autoclaves, pumps, engines, automatic stills, hot water tanks, etc.: and gas for student and laboratory burners, gas stoves, gas engines, etc. The installation of the new 75-horsepower Babcock and Wilcox boiler has increased the boiler capacity to 225-horsepower, consisting of one battery of three 75-horsepower boilers.

The abatement of smoke has always been a serious problem when bituminous coal is used in boilers that are designed for high-grade coals. The device now in use in one of our boilers consists of the addition of a Dutch oven with a long furnace roof that attains an exceptionally high temperature, a large combustion chamber back of the bridge wall, and horizontal baffles which make a longer passage for the gases before reaching the comparatively low-temperature boiler tubes. This promises to be a satisfactory arrangement for the elimination of smoke. However, there are several problems that must be solved before pronouncing the device a complete success. The slope of the tubes of the Babcock and Wilcox boiler from front to rear is great, and the special bricks, put on and supported by the lowest row of tubes, slide from time to time, making short-cut passages for the gases which cause the emission of smoke. We shall try to prevent this sliding by using ring tiles which have the additional advantage of more perfectly preventing the early contact of the incompletely burned gases with the comparatively cold lowest row of boiler tubes.

The original construction of the Babcock and Wilcox boilers has vertical baffles with cleaning holes in one side of the wall.

With horizontal baffles, when the boiler is being fired, there is no easy means of removing the soot and dust which accumulate on top of them. In the Heine boilers the removal of the soot and dust from the top of the horizontal baffles is accomplished by special permanent steam connections from the tubes headers, and this arrangement is desirable and would be effective with our present boiler with its horizontal baffles.

At present, working plans are being prepared for the construction of Dutch-oven furnaces in front of the two boilers not yet so equipped.

With the installation of the producer-gas engine-driven dynamo, the total rated capacity of the electric generators in the engine room is 125 kilowatts. The most economical operation of any electric generating unit is to operate it at its rated capacity. This has been the aim in our power plant, and in order to get the most evenly distributed load the operating of the refrigerating machinery, the electrically driven feed pump, the electric motor-driven air compressor, and the charging of the electric automobiles of the Philippine General Hospital, respectively, are carried on at the most convenient time. The installation of the steam-driven air compressor makes our system more flexible. The steam-driven air compressor is used whenever there is high electric load, which one dynamo cannot carry, in addition to the electric motor-driven air compressor. This arrangement avoids the starting of another electric generating unit, which would call for the firing of another boiler, with consequent increase of operating expenses. If the load of the dynamo is not sufficient, then the electric air compressor is operated, which saves the steam which would otherwise be consumed by the relatively uneconomical steam air compressor. After office hours, the load on the dynamo usually falls off and the electric automobiles of the Philippine General Hospital are charged until 6.30 p. m., when the load commences to increase and is soon high due to the lights in the Hospital. If the arc-light reflectors in the surgical rooms are not needed, or there is no unusual load by 9.00 p. m., the charging of one electric automobile may be begun. At about 10.30 p. m. another electric automobile is connected, and until 7.30 a. m. the dynamo load consists of refrigerating machines, electric automobiles, a few lights, and the electrically driven boiler feed pump. The load distribution of the plant is almost ideal, except the two electric elevators of the Philippine General Hospital which cause peak loads. However, they are intermittent and last only a

few minutes, and are fairly well carried by the dynamo, although sometimes as overloads.

Producer-gas plant.—The new dynamo driven by the producer-gas engine is unquestionably far more economical in operating expenses than the generating steam units. Exact figures of the cost of the production of power for the producer-gas plant are being prepared, and they will be compared with that for the dynamos driven by steam engines. The producer-gas plant is operated from 7.30 a. m. to 11.30 p. m. In this way there is no restriction in the use of the electrically driven machinery and electric apparatus, and at the same time the boiler is relieved from overload, thus prolonging its life and reducing the depreciation and running expenses as well as reducing the production of smoke by light firing.

In estimating the advantages of the producer-gas engine over the steam engine in this plant, one must remember that we use the exhaust steam from the steam engine for heating to the boiling point about 10,740 cubic meters of ordinary city water per year for the Philippine General Hospital. When we run the gas engine we have to heat this same amount of water by live steam. We shall endeavor to devise a method of using the exhaust gases of the gas engine for heating the water for the Hospital, in order to effect greater economy.

Engine room.—The total electric current generated and delivered at the switchboard, from July, 1912, to May, 1913, is 214,650 kilowatt hours as compared with 179,192 kilowatt hours for the corresponding months of the last fiscal year; an increase of 16.56 per cent.

The total cost of 214,650 kilowatt hours is ₱21,741.25, which, expressed in unit cost, is ₱0.10129 per kilowatt hour against ₱0.10279 per kilowatt hour of last year; a reduction of 1.46 per cent in unit cost. Of the total current generated, 59.31 per cent was consumed in the Philippine General Hospital, 8.83 per cent in the College of Medicine and Surgery, and the remaining 31.86 per cent in the Bureau of Science.

Boiler room.—The total amount of steam generated in the boilers, for eleven months—from July, 1912, to May, 1913—is 11,042,120 kilograms as compared with 9,944,858 kilograms for the corresponding months of last year; an increase of 9.93 per cent. The total cost of generating the 11,042,120 kilograms of steam at 120 pounds per square inch, gauge pressure, is ₱28,126.49. Expressing these quantities in unit cost, it gives ₱0.0025472 per kilogram against ₱0.0026839 per kilogram of

last year; a decrease of 5.09 per cent. Of the total weight of steam generated, 38.71 per cent was used in the Philippine General Hospital, 0.09 in the College of Medicine and Surgery, 6.06 in the Bureau of Science, 3.67 in pumping the tunnel, and the remaining 51.47 was consumed by the steam engines to generate electric power.

Mansfield gas-generator plant.—The original room of the gas retorts is, at present, occupied by the producer-gas engine, and the retorts were moved to the new extension of the power plant. One more Mansfield generator has been installed, making a total of four units. The gas generated from the retorts is manufactured from kerosene and Cape lubricating oil. This gas is supplied to the Bureau of Science, the University of the Philippines, and the Philippine General Hospital. The total production from July, 1912, to May, 1913, amounted to 370,361 cubic feet (10,488.6 cubic meters).

In April I offered the by-product tar from the manufacture of gas to the Bureau of Health for the use of the mosquito brigade. It was found suitable for use in swampy areas, and since then 2 barrels weekly have been furnished for this purpose.

Shop.—The primary object of the shop is to set up and repair without delay the power-plant equipment and scientific apparatus of this Bureau. The building of an experimental lime kiln and other special apparatus, as well as erecting special apparatus such as the ultra-violet apparatus for the sterilization of water for the Bureau of Science, have been done in our shop. Two hundred sixty-nine jobs, the value of which is estimated at ₱3,000, were completed in the carpenter and machine shop. Besides routine work from the Bureau of Science, a number of jobs, consisting mostly of repairing, making and nickel-plating surgical instruments, making descriptive geometry models, photographic camera, and fishing spoons, have been completed mostly for the Philippine General Hospital and the University of the Philippines.

THE PHILIPPINE JOURNAL OF SCIENCE AND OTHER PUBLICATIONS

Nos. 4, 5, and 6 of volume VII and Nos. 1, 2, and 3 of volume VIII of The Philippine Journal of Science were published during the fiscal year. Beginning with No. 1 of volume VIII the designation of Section B was shortened from The Philippine Journal of Tropical Medicine to Tropical Medicine. The designations of Sections A, C, and D remain as in volume VII.

The following are the titles of the articles printed in The

Philippine Journal of Science during the fiscal year. Names of members of the Bureau of Science staff are marked by asterisks (*).

SECTION A. CHEMICAL AND GEOLOGICAL SCIENCES AND THE INDUSTRIES

Adams, George I. Timor Island; its supposed volcano and its probable tectonic relations.

* Agcaoili, Francisco. The composition of various milks and their adaptability for infant feeding.

* Cox, Alvin J. The oxidation and deterioration of coal.

———, * Reibling, W. C., and * Reyes, F. D. Sand-lime brick and artificial sandstones in the Philippines.

* Dovey, E. R. A new type of laboratory condenser for use with volatile liquids in tropical laboratories.

———. The composition of carabao's milk.

* Eddingfield, F. T. Alternation and enrichment in calcite-quartz-manganese gold deposits in the Philippine Islands.

———. Gogo, Entada scandens Bentham, and its effect on gold and gold solutions.

———. Ore deposits of the Philippine Islands.

* Fanning, Paul, R. A Philippine natural bridge.

———. Geological reconnaissance of northwestern Pangasinan.

———, and * Eddingfield, F. T. The black sands of Paracale.

* Gibbs, H. D., and * Agcaoili, F. Philippine citrus-fruits; their commercial possibilities and a chemical study of a few of the most important varieties.

——— ———. Some Filipino foods.

———, and * Pratt, D. S. The absorption spectra of ortho- and paranitrophenol and para-nitrosophenol. New evidence of the quinoid structure of these compounds in alkaline solution.

——— ———. The mutual influence of hydroxyl and carboxyl and some related groups in the ortho position. A study of the absorption spectra of phenol, o-cresol, o-hydroxybenzyl alcohol, salicylic acid and its methyl ester, methyl ether of salicylic acid and its methyl ester, benzyl alcohol, benzyl acetate, benzyl methyl ether, benzyl chloride, and methyl benzoate.

———, * Williams, R. R., and Galajikian, A. S. Methyl salicylate IV. The saponification of methyl salicylate, methyl benzoate, and the methyl ether of methyl salicylate.

* Pratt, D. S. The optical efficiency of tinted glasses in relieving eye strain.

———, and * del Rosario, J. I. Philippine fruits: Their composition and characteristics.

———, and * Gibbs, H. D. The absorption spectra of phenoquinone, 2, 5-dianilinoquinone, 2, 5-dianilinoquinoneanil, and 2, 5-dianilinoquinonedianil (azophenine).

——— ———. The two phthaloximes: A study of their absorption spectra and constitution.

* Reibling, W. C. A bonus system for the purchase of Portland cement.

Tempongko, Clodoaldo. Sugar-cane experiments.

* Thurlow, L. W., and * Pratt, D. S. Extraction test of a modern sugar central.

SECTION B. THE PHILIPPINE JOURNAL OF TROPICAL MEDICINE, VOLUME VII, NOS. 4, 5, AND 6; SECTION B. TROPICAL MEDICINE, VOLUME VIII, NOS. 1, 2, AND 3

Ashburn, P. M., Vedder, E. B., and Gentry, E. R. The relationship of variola and vaccinia.

* Barber, M. A. The susceptibility of cockroaches to plague bacilli inoculated into the body cavity.

Boynton, William Hutchins. A note upon strangles in the Philippine Islands.

———. A study of the normal blood of the carabao.

———. Notes on the muscular changes brought about by intermuscular injection of calves with the virus of contagious pleuropneumonia.

Butler, C. S. Some carbohydrate reactions of the dysentery bacillus.

* Crowell, B. C. Status thymico-lymphaticus among Filipinos.

———, and Hammack, R. W. Intestinal parasites encountered in five hundred autopsies, with reports of cases.

Fox, Carroll. The plague outbreak in Iloilo.

Gilman, P. K. Appendicitis.

———. Axillary teratoma.

———, and * Crowell, B. C. Report of the pathological examinations for one year from the surgical clinic of the Philippine General Hospital.

Hammack, R. W. Primary sarcoma of the small intestine.

Heiser, Victor G. The outbreak of plague in Manila during 1912. The insidious beginning, with a discussion of probable factors concerned in its introduction.

Hilario, José S. Tumors of the pituitary gland. Report of a case of pituitary glioma.

Mitzmain, M. Bruin. The biology of Tabanus striatus Fabricus, the horsefly of the Philippines.

———. The bionomics of Stomoxys calcitrans Linnæus; a preliminary account.

———. The mechanical transmission of surra by Tabanus striatus Fabricus.

———. The rôle of Stomoxys calcitrans in the transmission of Trypanosoma evansi.

Musgrave, W. E., and Sison, A. G. The bone lesions of smallpox. Second report.

* Ruediger, E. H. The duration of passive immunity against tetanus toxin.

* Strong, Richard P., and * Crowell, B. C. The etiology of beriberi.

Teague, Oscar. A further note upon the influence of atmospheric temperature upon the spread of pneumonic plague.

Vedder, Edward B. A fourth contribution to the etiology of beriberi.

———, and Clark, Elbert. A study of polyneuritis gallinarum. A fifth contribution to the etiology of beriberi.

———, and * Williams, Robert R. Concerning the beriberi-preventing substances or vitamines contained in rice polishings. A sixth contribution to the etiology of beriberi.

* Walker, Ernest Linwood. Quantitative determination of the balantidicidal activity of certain drugs and chemicals as a basis for treatment of infections with Balantidium coli.

* Willets, David G. General conditions affecting the public health and diseases prevalent in the Batanes Islands, P. I.
———, and * Schöbl, Otto. Isolation of Diplococcus intracellularis meningitidis Weichselbaum from a case of cerebrospinal meningitis occurring in a native of the Philippine Islands.
The Philippine Islands Medical Association. Minutes of the Ninth Annual Meeting.

SECTION C. BOTANY

Brotherus, V. F. Contributions to the bryological flora of the Philippines, IV.
* Brown, W. H. The relation of Rafflesia manillana to its host.
———. The relation of the substratum to the growth of Elodea.
———, and * Graff, P. W. Factors influencing fungus succession on dung cultures.
Copeland, Edwin Bingham. Notes on some Javan ferns.
———. On Phyllitis in Malaya and the supposed genera Diplora and Triphlebia.
Diels, L. Three new species of Menispermaceae.
Hubbard, F. Tracy. On Eragrostis cilianensis (All.) Vignolo lutati.
Kränzlin, F. Cyrtandraceae novae philippinenses, I.
* Merrill, E. D. New or noteworthy Philippine plants, IX.
———. Nomenclatural and systematic notes on the flora of Manila.
———. Notes on Philippine Euphorbiaceae.
———. On the identity of Evodia triphylla DC.
———. Studies on Philippine Rubiaceae, I.
———. The Pineda monument and the probable site of the first botanic garden in the Philippines.
Rehm, H. Ascomycetes philippinenses collecti a clar. C. F. Baker.
* Robinson, C. B. Roxburgh's Hortus Bengalensis.
Sydow, H. and P. Descriptions of some new Philippine fungi.
Wainio, E. A. Lichenes insularum philippinarum, II.
Warnstorf, C. Die Sphagna der Philippinen.

SECTION D. GENERAL BIOLOGY, ETHNOLOGY, AND ANTHROPOLOGY

Baker, C. F. A study of caprification in Ficus nota.
Bernhauer, Max. Neue Staphyliniden der Philippinen.
* Beyer, H. Otley. Origin myths among the mountain peoples of the Philippines.
Borchmann, Fritz. Lagriiden und Alleculiden der Philippinen (Coleoptera).
* Christie, Emerson Brewer. Notes on the woodworking industry of San Vicente, Ilokos Sur.
———. The stone industry at San Esteban, Ilokos Sur.
Cowles, R. P. The habits of some tropical crustacea.
Heller, K. M. Neue Käfer von den Philippinen.
———. Philippinische Rüsselkäfer.
* Jones, Charles R. The cigarette beetle (Lasioderma serricorne Fabr.) in the Philippine Islands.
———. The coconut leaf-miner beetle, Promecotheca cumingii Baly.
Ohaus, Fr. Nachträge und Berichtigungen zu: "Die Ruteliden der Philippinischen Inseln."
Oshima, Masamitsu. Description of a new gecko from Botel Tobago Island.

Salt, Alexander E. W. Francisco de Carriedo y Peredo.

* Seale, Alvin. Description of a new Acanthocybium from the Philippine Islands.

———. Notes on Philippine edible mollusks.

———. Some poisonous Philippine fishes.

Weise, J. Über Chrysomeliden und Coccinelliden der Philippinen: III Teil (Coleoptera).

The amount and variety of material available for publication has increased during the year. A part of this is secured through an arrangement with the Bureau of Agriculture whereby such technical papers from the Alabang laboratory as are desirable are published in Section B of The Philippine Journal of Science. The United States Army Board for the Study of Tropical Diseases as they Exist in the Philippine Islands, the University of the Philippines, and the Bureau of Health, as heretofore, offer material on subjects pertaining to medical sciences or to zoölogy.

Much effort has been expended toward obtaining prompt issue of the Journal numbers. Some improvements over the condition of last year have been made. The most extensive single publication issued during the year was A Flora of Manila, 490 pages, Bureau of Science Publication No. 5. This work treats in manual form somewhat over 1,000 species, with descriptions of, and keys to, families, genera, and species, and other data. It is the most generally useful botanical publication yet issued by the Bureau. The publication is of especial value to teachers and students of botany and biology, as it gives, in compact form, means of determining most of the common plants found in and about towns in the Philippines. Of minor importance are the new edition of the Catalogue of Plants Cultivated in the City Nursery at the Cementerio del Norte, issued early in the year by the city of Manila and an article on Philippine Shade Trees and Ornamental Plants prepared at the request of the Director of Public Works and published in the Quarterly Bulletin of the Bureau of Public Works. Both publications were prepared to stimulate official and private interest in the matter of planting and care of ornamental trees and plants. A short article on sugar, The Financial Loss Occasioned by Harvesting Unripe Sugar Cane, by D. S. Pratt and L. W. Thurlow, was contributed to the Philippine Agricultural Review.

Some effort is being made to unify the style of the numerous blank forms and labels used in the Bureau. While the matter of uniformity should not be too rigorously insisted upon, it seems

worth while to strive for greater similarity of type and headings than has existed.

The stock of the "Publications" folder issued in 1911 was exhausted. As the old folder has been found to be convenient and effective, the same make-up with the necessary additions has been used for a new edition.

The Bureau of Science Press Bulletins, which heretofore have been used exclusively for material from the division of mines of this Bureau, were made more general in character, and will in the future include information of a suitable character from any division of the Bureau.

Two years ago the mailing list of the Journal comprised 722 names and last year 855. It was our desire to make it an even thousand at the end of the present fiscal year, and we are only three short of that number, an increase over last year of 142 names, of which 106 were paid subscriptions. Of the 997 names on the mailing list, 447 are "paid" subscriptions, 427 are exchanges, 74 are for review, and 49 are free copies. The increase in paid subscriptions during the year has been 30 per cent as against an increase of between 20 and 25 per cent for last year.

The matter of keeping the Journal and publications accounts paid up is one of considerable difficulty, but each year seems to show better results. In every instance our outstanding accounts are less than they were at the end of the last fiscal year, and at the same time more Journals and publications have been sold. The total receipts from the Journal and other publications have been ₱6,021.09, or ₱1,272.57 more than for the last fiscal year. The fact that our outstanding accounts are at present less than those at the end of the last fiscal year will reduce this gain somewhat. It is estimated that the cost of printing the Journal and reprints therefrom for free distribution to contributors has been ₱23,407.48 for the present year as against ₱17,918.15 for the previous year. However, the very large number of plates and great number of pages in the plague number of Section B, the memorial number, and other unusual expenses have tended to add to the total cost of printing.

The value of the general publications of the Bureau of Science sold is ₱1,807.57, or ₱84.05 more than for the previous fiscal year, but ₱496.10 less than in 1911, owing largely to the fact that The Bontoc Igorot by A. E. Jenks and No. 8 of Volume I of the Journal which contained an article on the Non-Christian Tribes of Northern Luzon by the Honorable Dean C. Worcester

were exhausted last year and nothing has yet been published to take their place. Either of these articles, if revised and reprinted, would find a ready sale. It was anticipated that the Manual of Silk Culture would find a ready sale, but it has not done so.

There have been no new agents designated during the past year. Some of our present agents do not seem as active in the interest of the Journal and our general publications as they should be. It is probable that a large number of sales could be effected in the United States if we could secure active and responsible agents in some half dozen of the larger cities of the country.

During the year about 2,000 personal letters were sent out. In each of these was inclosed one of our publication folders. Without doubt the increase in paid subscriptions was largely due to these letters, and they will probably be productive of results for another year or two. We have also mailed several thousands of our new publication folders. Our personal letters and publication folders have been pretty well distributed over America, and have gone to most scientists and scientific institutions of reputation, so that possible results may be obtained in that way. There are still many new and untried ways of advertising the Journal, and one may be discovered which will be successful in attracting the class of people to be interested. This has been a successful year for the Journal, and the coming year should also be productive of returns from advertising done during the two previous years.

The attic is used as a place to store the Journal and other publications as well as for the preparation of those for mailing. This is the only available place. It is very unsatisfactory and undesirable from many standpoints, especially on account of the weight of the publications, the danger of fire, and the control of employees working there.

CLERICAL DIVISION

Personnel.—Mr. A. E. Southard, chief clerk, cashier, and disbursing officer, was absent on leave from the Islands more than one-half of the present fiscal year, during which time his work was very satisfactorily performed by Mr. C. J. Stancliff. Mr. Stancliff has now resumed his duties as property clerk. Since January Miss Celesta Cromer has been on leave in Europe and the United States. Mrs. Dora Chapman has been employed temporarily as a stenographer in her place. Mrs. M. E. Brown,

who has been an employee of this Bureau for more than two years, resigned in January on account of ill health, and her position has been very satisfactorily filled by Mrs. M. Davis. Mr. G. M. de Ubago, who was assistant and acting property clerk, resigned, effective June 15, 1913. Mr. Ubago has been a member of the Bureau since its organization and by reason of his length of service and more than ordinary ability was a very valuable and efficient clerk. Our Filipina stenographer and typist who, a year ago, showed promise of becoming a very competent clerk has continued to progress and is now in charge of the correspondence and accounting connected with The Philippine Journal of Science. Much economy can be practiced if really competent Filipino clerks can be secured to do work which it formerly was thought absolutely necessary to have done by Americans.

Filing.—This work has not progressed very rapidly nor as satisfactorily as seemed possible. It was expected that it would take three or four months, but already a year has elapsed and the work is not yet completed. However, our records are more accessible than they were twelve months ago. Filing is one of the most difficult and important parts of any office work, and much of our former difficulty in keeping our records readily accessible has been due to the underestimated importance of the work and in leaving it to the less competent clerks. There are at present two very hard-working Filipino clerks engaged with the records, and, with the work well started, by steady application they will be able to keep up with the current work and bring the indexing of the older records to completion.

The two bicycles purchased two years ago have given excellent service and have unquestionably saved much more than their cost in car fare and carromata hire, besides giving us a system of quick messenger service otherwise unobtainable. They have had hard wear and will soon need to be replaced.

The new filing cabinets for the index cards to the files received a few months ago are satisfactory, and are now in use.

The purchase and installation of a watchman's time clock with keys distributed about the buildings and premises insures the watchman visiting all parts of the buildings and grounds a number of times each night and adds to his efficiency.

Our telephone service seems much improved since it has been taken over by the Executive Bureau. Trained and competent operators are furnished at a very reasonable salary. The service of late has been somewhat annoying owing principally to de-

fective and worn-out equipment. I have been informed that a new telephone switchboard for this Bureau is being made and will soon be installed.

The dissension and general dissatisfaction relative to the compensation of the muchachos which were noticeable before the adoption of the present rules and regulations governing that matter seem entirely to have disappeared. The rules adopted about a year and a half ago work almost automatically and are very satisfactory.

Transportation facilities for official use of members of the Bureau seem adequate and satisfactory. Any member of the Bureau desiring transportation can almost always have it within an hour from the time of making his request. A small automobile runabout to be operated by the man using it would be very desirable, and could probably take the place of the carromata.

1914 PHILIPPINE EXPOSITION AND 1915 PANAMA-PACIFIC INTERNATIONAL EXPOSITION

Many of the lines of work of the Bureau of Science cannot well be exhibited, but some of our collections and our industrial investigations are of exceptional popular interest. Demonstrations of the industrial operations of mining, fisheries, and silk culture and the products made from Filipino raw materials, such as paper, sand-lime bricks, tiles, vitrified bricks, cement, and artificial marbles, could be shown. Exhibits of Philippine coal; nipa and its products—such as alcoholic beverages and nipa sugar—products of coconuts, oranges, and other fruits; tan bark; cutch; rocks and minerals; corals; fossils; shells; a representative herbarium; fishing outfits; birds and other natural history specimens; as well as a wonderful display of colored transparencies and photographs could be made if funds were available. Models showing the mineral districts, underground workings in mines, the gold production by year, native iron smelters, pottery works, a modern sugar central, and photographs showing the working of various dredges and mills could be made for a small sum. Probably the most acceptable and popular exhibit in the Panama-Pacific Exposition would be collections from the Christian and non-Christian tribes, consisting of a representative exhibit from each tribe. I have outlined an exhibit for the chairman of the 1915 Panama-Pacific International Exposition which could be delivered in Manila for ₱40,000. This can be made smaller if desirable, and there is a great deal which could be done for a local exhibit that would require practically no funds; however, two or three thousand

pesos should be available for making models of modern sugar centrals and other instructive industrial operations, in order that the knowledge of the Bureau of Science should be properly disseminated and serve its greatest usefulness.

THE AQUARIUM

In the early part of the year it was decided that 1-inch glass be ordered to replace the thinner glass in the aquarium, as the latter has a factor of safety of less than two, and that rigid iron frames with planed surfaces be constructed for the heavy glass. The iron frames have been completed and installed, and the 1-inch glass ordered from the United States has arrived and has been put in place. The design of the iron frames is such that certain parts are protected from the salt water in the aquaria only by a preservative coating, and I fear that this will be insufficient to prevent discoloration of the water due to corrosion of the iron. The Kinney pump for the circulating system also has been installed, and several other minor changes have been made to facilitate the operation of the aquarium. There yet remain to be accomplished the construction of a roof over the shark tank, the concrete garden seats and railings along the promenade over the aquarium tunnel, the completion of the gates to the crocodile tank, and a few minor details. The Bureau of Public Works will complete these as soon as possible. If the iron frames do not corrode, the system will be in readiness to receive such material as the ichthyologist, who is now accompanying the Honorable the Secretary of the Interior on an inspection trip around the eastern coast of Luzon, may bring back with him. A collecting trip, especially to secure material, will be made as soon as the aquarium is ready to receive it and the aquarium then can be opened to the public. The delay in the arrival of the glass has given a year for the grass and vines to grow, so that the aquarium grounds are now beautifully parked.

It is necessary to provide for the operation and maintenance of the aquarium; an admission fee will be charged, the proceeds to go toward its support. The life of aquarium material averages only a few months, so that the cost of frequent expensive collecting trips will have to be borne in addition to the salaries and wages of the employees at the aquarium. The Bureau will need to be guaranteed against a deficit in the operation of the aquarium not covered by receipts, and it is requested that ₱5,000 be added to the annual appropriation of the Bureau of Science for this purpose.

RECOMMENDATIONS

It has been four years since this Bureau has had an increase in appropriation, in spite of the fact that the demands made upon it have increased in every direction and the work has continued to grow at a steady and almost amazing rate as shown by the foregoing report and those of the two previous years. Each year new lines of work have been undertaken and other additions shown to be desirable. The Bureau must continue to develop and add new phases of the work as the country grows and as the desire for accurate study and information concerning the conditions which surround us is extended. However, such new phases cannot be added and developed in their greatest efficiency without funds to maintain the expansion.

This Bureau has enjoyed the confidence of other branches of the Government and the public, and there has been a constantly growing desire to consult our scientists on theoretical and practical matters and problems pertaining to mining, commercial and industrial enterprises, and health. Frequently, we are able to supply the information desired simply by reference to our publications, but in some cases we are unable to assist because of insufficient staff and apparatus. Last year my report showed an increase of 45 per cent for the year in the number of routine biological examinations; an increase of 49 per cent in routine samples of rocks and minerals, soils, fertilizers, cements, clays, metals and alloys, road materials, stone, gravel, sand, concrete, water, coal, standardization of weights and measures, etc.; and an increase of 29 per cent over the previous fiscal year in the number of analyses of meat and meat products, fish and fish products, milk, butter, cheese and other dairy products, canned vegetables, flour, infants' food, tea, coffee, sugar, jam, jelly, marmalade, vegetable oils, essences, beverages, etc. There has been a further corresponding increase in all branches of the Bureau work during the fiscal year which shows how the work of the Bureau of Science has grown without an increase in the allotment of funds.

The work of maintaining in a constantly growing bureau what is in effect a department of information has seriously encroached upon our research and handicapped us in carrying on new lines of investigation as well as completing those already begun. Formerly, there were unfilled authorized civil service positions in this Bureau which made the system flexible. At the present time, practically every position is filled and we carry as many temporary employees as we can afford. We are in the greatest need of more scientific employees and laboratory space

and equipment to handle the additional work which devolves upon us on account of the growth of the laboratory.

The expansion of the Bureau has also brought with it the necessity of a greater expenditure for clerical work. On account of the increase in the size of the library, an additional technical worker, with good technical training and considerable experience, is very much needed to keep the work up to the required standard. A large amount of work is done in the library for the University of the Philippines, and it would not be an unfair arrangement for the university to pay to this Bureau an amount equivalent to the salary of one additional trained librarian in case such an employee cannot be provided for by direct appropriation. Also, as stated in my last annual report, a draftsman is needed to make ornithological, botanical, and entomological drawings and to mark copy for illustrations for The Philippine Journal of Science and other publications. A man for this purpose would have his time fully occupied.

New testing laboratory.—As was pointed out in my last annual report, the congested condition in our cement-testing laboratory which was originally arranged for 5 employees and in which we now have 17 working, is serious. Demands are more and more frequently being made upon the Bureau of Science to conduct researches in engineering for the benefit of the public. The testing of building materials cannot stop with that of cement alone; it must include many important adjuncts, and adequately to provide for such work additional machinery, quarters, and probably additional employees will be needed. We should at the present time be equipped thoroughly to test mechanical and electrical apparatus as well as ordinary construction and other materials such as we now undertake. Act 2264, section 3-c of the Third Philippine Legislature, special session of 1913, appropriated ₱50,000 subject to the release of the Governor-General for a testing laboratory building. I have requested the authorization of the release of these funds, and assume that the testing laboratory is assured.

Additional room needed.—Two years ago the east wing of the laboratory building was first occupied by the library, the sections of fisheries and of ornithology, the entomological collections and laboratories, and the division of mines. It was thought at that time that those branches would be accommodated for several years to come. The central scientific library of the Government, which is the scientific branch of The Philippine Library, is housed in the Bureau of Science. The library has been added to by the various colleges of the University of the Philippines and by other

branches of the Government. The available space has rapidly been filled, and even now certain sections are crowded. Frequent moving of large sections of books in order to shelve new sets is far from economical, and as the limit of the capacity of the library is approached such changes become necessary at more and more frequent intervals, since it is impossible to predict with certainty what sections will grow most rapidly. More room and additional shelf space for the care of the scientific books will be urgently needed before they can be provided.

We have in the Bureau of Science the best collection of Philippine plants in the world. The scientific value of this botanical collection cannot be estimated, for it would be impossible to replace the larger portion of it, but there is no doubt that the herbarium has an immediate cash value of ₱30,000. In its present location the herbarium is in danger of destruction by fire. Plans for safer housing of the collections in a fire-proof building should be made. The present quarters give very little light, now that they are stored full of herbarium cases and are not at all adapted to the needs of a herbarium.

The present arrangement of the clerical force is very unsatisfactory. The office of the chief clerk is on the first floor; the majority of clerks are housed in a large room over the serum laboratory; the assistant to the editor of The Philippine Journal of Science and the clerks that have to do with the Journal and other publications are on the second floor, and the clerks who wrap and mail the publications are in the attic. This is a very unsatisfactory arrangement. The clerks who wrap the publications of the Journal should be under the direct supervision of the assistant to the editor. All clerks should be segregated so that they may be easily supervised, and all of these various branches should be near the office of the director of the Bureau. The large room at present occupied by the herbarium is not at all well adapted to the needs of the botanists, but it would make an admirable general office in which could be placed the entire clerical force, including the proof readers and others connected with The Philippine Journal of Science and other publications. This centralization would result in better discipline, greater efficiency, and the saving of much time.

I have the honor to recommend the appropriation of ₱50,000 to complete the new wing for which one-half has already been provided in Act 2264 of the Third Philippine Legislature, special session of 1913, in order that we may provide for a fire-proof building in which to house the valuable botanical collections

and in order to provide room to which we can transfer other branches of the work now occupying the new wing of the Bureau and which in turn would provide suitable expansion for the library. The herbarium is rapidly increasing in size, and would require at least one-half of the additional building requested.

Water survey.—For several years this Bureau has had at least one chemist engaged in making water analyses, of which up to the present time we have performed over one thousand from artesian wells, dug wells, reservoirs, springs, rivers, etc. In spite of this, our knowledge of the quality and quantity of available Philippine water supplies is extremely limited. Considerable misconception exists concerning the value of results obtained from the ordinary sanitary, mineral, and bacteriological analyses of water. It is commonly supposed that such examinations may be interpreted in the same manner as other analyses, for instance, as the analyses of iron ore. However, as a matter of fact the bacterial count of water has little significance after a sample has been drawn for an hour or two without being kept on ice, and sanitary and mineral analyses of water should be considered more in the nature of a series of experiments than as giving results from which one may make a direct interpretation of the potability or medicinal value of the water. All classes of water analyses simply assist us to judge the character of the water. Without an accurate knowledge of the normal constituents of the source, the conditions under which the sample was taken, and the other factors which influence it, it is impossible to pass judgment upon a water. An investigation and study of all medicinal and thermal springs in the Islands should be undertaken, and a reservation as a public domain of a suitable area surrounding those of value should be made. It seems to me that it is a duty the Government owes to future generations to provide an adequate water survey at the present time. When funds are available, an appropriation should be made to this Bureau for carrying on a careful survey of Philippine water supplies.

Iloilo sugar laboratory.—The continued drought of 1912 delayed the planting of sugar cane to such an extent that when it was begun the season was already far advanced. Many of the earlier seeded fields did not sprout at all and had to be replanted; during the following rainy season two typhoons swept the Visayan Islands in swift succession, and the same region was next visited by a swarm of destructive locusts. At the beginning of the season the prospects were unfavorable, and this combination of misfortunes practically destroyed many crops. Furthermore,

due to the large European beet-sugar crop and the largest crop of cane sugar ever grown in Cuba, very low prices have prevailed, and there has been very little demand for Philippine sugar on the markets of the United States. One trial shipment of 4,115,704 kilograms was made early in the season as against 176,195,210 kilograms last year. The Formosan crop was almost an entire failure, and for this reason middle and lower class Philippine sugars have been in demand in the markets of China and Japan and have brought very good prices. The first shipments for the fiscal year 1913 have been 90,256,845 kilograms as against 27,075,031 kilograms for the fiscal year 1912. Nos. 1 and 2 sugars have had few buyers.

The sudden change of market has had a marked effect on our laboratory work. When sugar was shipped to the United States sales were made on a polariscopic basis. This year the Chinese dealers often have paid more for sugar simply on the color and feel than its polarization warranted. This, as well as the short crop, has affected the number of samples received. In spite of all these circumstances, the total number of samples received and polarized in Iloilo during the past fiscal year is 3,155, only 50 samples less than the number for the previous fiscal year, which shows that the laboratory has greatly grown in the estimation of the planters and dealers.

Two central sugar mills have been started in the Visayan Islands during the past year. They have a rated capacity of 15 tons of sugar in twenty-four hours each, but neither has ever been able to obtain the rated capacity. However, both mills have been highly successful when compared with the former crude methods of extraction. These two mills have been so successful that plans have been made to have 7 central mills in operation next season. In spite of their apparent success, the local central mills are doing very poor work with poor operation. They are vastly better than the native process, but one cannot help but regret the loss which might be converted into a profit. The hacenderos are accustomed to cheap labor. It is hard for them to realize the advantage of paying a high-class man several hundreds of pesos a month to operate the mill. In many cases such a man will save his entire month's salary in a single day. Our expert assisted in a test at one mill in order to demonstrate the loss, and it was shown that, if the lost sugar be figured at 28.5 centavos a kilogram, the daily loss was ₱440. A sugar central mill no matter how small must be chemically controlled.

Where it has not been feasible to erect central mills, the centrifugal alone has been used to good advantage as a means of

improving the grade of native sugar. The cane is milled and defecated in the usual manner, and the evaporation continued in the open cauas until a striking point at a temperature of 111° C. is reached, when it is ladled into graining tanks and allowed to cool and crystallize. After crystallization, the massecuite is removed to the centrifugal, where it is purged without washing and yields a sugar having a sucrose content of from 93 to 95 per cent. The sugar is soft, and the color is dark as no water is used, but the slight improvement in color by washing would not compensate for the sugar washed away in an attempted improvement.

Our records show that last year the purity of the cane attained a maximum very early in the season, probably due to the lack of rain which stopped the growth and induced ripening. Later in the season the grade of the sugar was lower, which indicates that the cane became overripe. This year, however, the purity increased regularly until January before it began to decline, indicating overripeness. It is noteworthy that the average purity for this year is 2 per cent less than for last, which indicates that a greater amount of green cane was cut with the consequent loss to the planter.

We have carried on some experimentation and research with cane from La Granja station of the Bureau of Agriculture at La Carlota. What we have been able to do is merely a beginning. In my last report I indicated the desirability of obtaining a piece of land in or near Iloilo where the cane can be more closely watched and the work carried out to better advantage. Never before has it been more desirable to have funds for the establishment, equipment, and maintenance of a suitable experimental farm. Experimental work carried on in Iloilo should materially assist the grower throughout the Archipelago and in the development of the sugar-cane industry of the Philippine Islands.

I have given this account in order to show that, in addition to our laboratory work of polarizing sugars, there is a large amount of instruction work with regard to the planting and harvesting of cane, as well as to the perfect recovery of the sugar which should be given to the planters. Thousands of pesos could be saved annually to the sugar grower if he were familiar with the precautions which he should take. Attention has already been called to the desirability of creating a sugar division in this Bureau consisting of at least three men. With such a corps of workers, there would be time to do field work and give instruction which would forestall the extravagant practices now in vogue among some of the sugar planters. This year a press

bulletin has been issued on The Financial Loss Occasioned by Harvesting Unripe Sugar Cane. It is especially recommended that funds be appropriated to this Bureau to enable us to carry on work among the sugar planters as indicated.

There is need for a model central sugar mill at Iloilo. Iloilo is the center of the sugar industry, and sugar men from many provinces trade there. More hacenderos could be reached here than at any other place. There are many central mills of the smaller type being erected throughout the country, and their owners are absolutely ignorant regarding mills and their control. There is sufficient cane grown in the vicinity of Iloilo to operate a 15-ton central mill during the season, and it could very profitably operate in remelting and reboiling low-grade sugars in the idle season, so that no shut down would be necessary and it would be entirely self-supporting. Such an institution would serve as a training school for mill operators. If funds are available, no better investment could be made by the Government than to build and operate such a mill and to use it in showing the people how to save the many thousands of pesos that are being wasted daily because of inexperience and lack of knowledge.

Coöperative work.—The Bureau of Science has continued to assist the College of Medicine and Surgery and the College of Liberal Arts of the University of the Philippines by detailing some of its best men to give instruction in chemistry, botany, tropical medicine, medical zoölogy and parasitology, pathology and bacteriology, immunity and serum therapy, disinfection and disinfectants, and medical entomology. We have been glad to do this because it has given to the students of the University not only good instructors, but contact with men engaged in active practical work. The more minute record of the detail of these men has already been given in discussing the work of the various branches of the Bureau. Last year I called attention to the belief by some that men are more rapidly advanced in the University than in the Bureau of Science, and that there should be no discrimination between these institutions of the Government and that the appropriation for salaries and wages for the Bureau of Science should be just as liberal as in any of the others. I desire to repeat my recommendation that an appropriation of ₱30,000 be added to that of the Bureau of Science in order that parallel salaries may be maintained between this institution and other branches of the Government.

Former recommendations.—Since no current appropriation bill has been passed for the last three years, no action has been

taken on my previous recommendations with regard to funds for the investigation of animal diseases and insects injurious to agricultural products, the purchase of books necessary to complete sets now in the central scientific library, reissuing exhausted editions of certain publications, or enlarging the scope of our present work on the fish and fisheries of the Philippine Islands. The wisdom of providing funds for this work is as evident as heretofore, and I heartily recommend that appropriations for these purposes be made when funds are available.

Tables showing the routine work performed and supplies manufactured and disposed of during the fiscal year 1912–13 by the Bureau, and a financial statement showing the appropriation and how it was expended, are attached hereto.

ALVIN J. COX,
Acting Director, Bureau of Science.

To the Honorable,
The SECRETARY OF THE INTERIOR.

TABLE I.—*Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1913, as compared with the fiscal year 1912, by number or quantity.*

[July 1, 1913.]

Division of the Bureau.	Samples or units.		Decrease.	Increase.
	1912	1913		
General, inorganic, and physical chemistry:				
Metals and alloys	36	45		9
Rocks, minerals, natural pigments, and similar substances	46	15	31	
Clays, shales, limestones, limes, wall plasters, cements, and slags	83	55	28	
Fertilizers	16	10	6	
Soils and similar substances	61	14	47	
Coal analyses	20	58		38
Steaming tests	2		2	
Calorimetric tests of fuels	8	42		34
Waters	146	187		41
Crude chemical and miscellaneous analyses	33	35		2
Standard solutions	33	10	23	
Physical tests of wire, twine, fibers, textiles, paper, and similar articles	14	48		34
Cements	8,476	9,535		1,059
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	221	54	167	
Standardization of road materials	27	62		35
Standardization of units of measure—				
Lengths		96		96
Capacities	370	154	216	
Weights	620	667		47
Miscellaneous	156	210		54
Total	10,368	11,297		929
Organic chemistry:				
Urines, clinical and toxicological analyses	[a]6,143	2,666	3,477	
Essential oils and essences	6	37		31
Petroleum and products, copra, and similar materials	17	71		54
Paints, varnishes, and linseed oils	41	46		5
Gums, resins, and similar materials	1	3		2
Paper and similar materials	126	107	19	
Gastric juice, clinical examinations	7	12		5
Foods, alcohols, and beverages	1,288	1,035	253	
Food preservatives and coloring matters	32	19	13	
Medicines and similar articles	84	232		148
Miscellaneous	91	77	14	
Total	7,836	4,305	3,531	

[a] Includes all urines examined by the biological laboratory.

TABLE I.—*Comparative table of routine work, etc.*—Continued.

Division of the Bureau.	Samples or units. 1912	1913	Decrease.	Increase.
Mines: Assays	413	288	125	
Biological laboratory:				
Fæces	21,684	34,530		12,846
Sputum	3,861	5,770		1,909
Blood	2,976	25,539		22,563
Urine	(a)	6,974		6,974
Gonococci	15,971	20,522		4,551
Waters	742	1,077		335
Necropsies	54	87		33
Miscellaneous	3,482	57,972		54,490
Total	48,770	152,471		103,701
Serum section of the biological laboratory:				
Vaccine virus (doses)—				
Prepared	2,148,186	2,237,672		89,486
Disposed of	2,107,359	2,419,723		312,364
Antirinderpest serum (cubic centimeters)—				
Prepared		27		27
Disposed of	694,666	417	694,249	
Plague prophylactic (cubic centimeters)—				
Prepared		3,660		3,660
Disposed of		330		330
Mallein (doses)—				
Prepared	532	512	20	
Disposed of	641	280	361	
Diphtheria antitoxin (units)—				
Prepared	639,000	983,000		344,000
Disposed of	475,500	830,500		355,000
Tetanus antitoxin (units)—				
Prepared	1,821,700	1,406,500	415,200	
Disposed of	894,500	1,986,000		1,091,500
Cholera prophylactic (cubic centimeters)—				
Prepared				
Disposed of				
Antiplague serum (cubic centimeters)—				
Prepared	60	9,540		9,480
Disposed of	60	9,240		9,180
Anticholera serum (cubic centimeters)—				
Prepared				
Disposed of		2		2
Antidysentery serum (cubic centimeters)—				
Prepared	1,950	2,280		330
Disposed of	780	3,130		2,350

[a] Included under organic chemistry.

TABLE I.—*Comparative table of routine work, etc.*—Continued.

Division of the Bureau.	Samples or units. 1912	1913	Decrease.	Increase.
Serum section of the biological laboratory—Continued.				
Antityphoid serum (cubic centimeters)—				
Prepared	52	3,000		2,948
Disposed of	1	30		29
Tuberculin, human (cubic centimeters)—				
Prepared	575	26	549	
Disposed of	328	326	2	
Tuberculin, bovine (cubic centimeters)—				
Prepared	224	50	174	
Disposed of	61	184		123
Antigonococcus prophylactic (cubic centimeters)—				
Prepared				
Disposed of				
Antistaphylococcus aureus and albus (cubic centimeters)—				
Prepared		622		622
Disposed of		450		450
Normal horse serum (cubic centimeters)—				
Prepared	25,160	20,580	4,580	
Disposed of	990	1,950		960
Normal salt solution (liters)—				
Prepared				
Disposed of	2		2	
Typhoid vaccine (cubic centimeters)—				
Prepared		1,760		1,760
Disposed of		422		422
Tuberculin vaccine (cubic centimeters)—				
Prepared				
Disposed of				
"A" serum for exopthalmic goitre (cubic centimeters)—				
Prepared				
Disposed of				
"B" serum for exopthalmic goitre (cubic centimeters)—				
Prepared				
Disposed of				
Rabies vaccine (doses)—				
Prepared				
Disposed of				
Anthrax vaccine No. 1 (cubic centimeters)—				
Prepared				
Disposed of				

TABLE I.—*Comparative table of routine work, etc.*—Continued.

Division of the Bureau.	Samples or units.		Decrease.	Increase.
	1912	1913		
Serum section of the biological laboratory—Continued.				
Anthrax vaccine No. II (cubic centimeters)—				
Prepared				
Disposed of				
Staphylococcus aureus vaccine (cubic centimeters)—				
Prepared	406	2	404	
Disposed of	456	44	412	
Antigonococcus vaccine (cubic centimeters)—				
Prepared	370	1, 146		776
Disposed of	274	42	232	
Normal rabbit serum (cubic centimeters)—				
Prepared				
Disposed of				
Antogenous staphylococcus vaccine (cubic centimeters)—				
Prepared	20		20	
Disposed of	385		385	
Staphylococcus albus vaccine (cubic centimeters)—				
Prepared		85		85
Disposed of		85		85
B. coli vaccine (ampules)—				
Prepared		135		135
Disposed of				
Streptococcus vaccine (ampules)—				
Prepared		82		82
Disposed of		23		23
Antistreptococcus serum (cubic centimeters)—				
Prepared		2, 070		2, 070
Disposed of		510		510
Vaccine virus (doses)	2, 107, 359	2, 419, 723		312, 364
Antirinderpest serum (cubic centimeters)		553, 666. 33		553, 666. 33
Mallein (doses)	532	280	252	
Other serums (cubic centimeters)		2, 833, 268		2, 833, 268
Total	2, 107, 891	5, 806, 937. 33		3, 699, 046. 33
Miscellaneous:				
Photographs	9, 349	14, 491		5, 142
Natural history specimens	34	84		50
Shop orders	243	269		26
Miscellaneous work	34	36		2
Total	9, 660	14, 880		5, 220

TABLE II.—*Comparative table of routine work performed (free and cash) and supplies manufactured and sold during the fiscal year 1913, as compared with the fiscal year 1912, by value.*

[July 1, 1913.]

Division of the Bureau.	1912	1913	Decrease.	Increase.
General, inorganic, and physical chemistry:				
Metals and alloys	₱187.50	₱474.60		₱287.10
Rocks, minerals, natural pigments, and similar substances	624.00	142.50	₱481.50	
Clays, shales, limestones, limes, wall plasters, cements, and slags	916.44	619.50	296.94	
Fertilizers	142.30	108.00	34.30	
Soils and similar substances	1,691.00	254.00	1,437.00	
Coal analyses	346.00	788.00		442.00
Steaming tests	120.00		120.00	
Calorimetric tests of fuels	160.00	620.00		460.00
Waters	4,800.00	5,425.00		625.00
Crude chemical and miscellaneous analyses	344.80	426.65		81.85
Standard solutions	150.50	70.00	80.50	
Physical tests of wire, twine, fibers, textiles, paper, and similar articles	14.00	190.00		176.00
Cements	6,738.80	9,129.05		2,390.25
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	436.50	271.00	165.50	
Standardization of road materials	132.50	515.00		382.50
Standardization of units of measure—				
Lengths		67.20		67.20
Capacities	194.80	19.00	175.90	
Weights	71.58	69.50	2.08	
Miscellaneous	114.22	174.87		60.65
Total	17,184.94	19,363.87		2,178.93
Organic chemistry:				
Urine, clinical and toxicological analyses	[a]18,632.00	1,992.00	16,640.00	
Essential oils and essences	48.50	288.00		239.50
Petroleum and products, copra, and similar materials	278.00	485.00		207.00
Paints, varnishes, and linseed oils	453.88	370.50	83.38	
Gums, resins, and similar materials	7.00	20.00		13.00
Paper and similar materials	1,260.00	1,223.00	37.00	
Gastric juice, clinical examinations	525.00	325.00	200.00	
Foods, alcohols, and beverages	11,322.50	12,519.50		1,197.00
Food preservatives and coloring matters	440.00	129.00	311.00	
Medicines and similar articles	526.00	1,364.00		538.00
Miscellaneous	812.50	548.00	264.50	
Total	34,305.38	19,264.00	15,041.38	
Mines: Assays	895.75	794.67	101.08	

[a] Includes all urines examined by the biological laboratory.

TABLE II.—*Comparative table of routine work, etc.*—Continued.

Division of the Bureau.	1912	1913	Decrease.	Increase.
Biological laboratory:				
Fæces	₱138,667.00	₱274,334.00		₱135,667.00
Sputum	11,553.00	17,288.00		5,735.00
Blood	17,545.00	80,786.00		63,241.00
Urine	(a)	26,991.00		26,991.00
Gonococci	47,913.00	54,330.00		6,417.00
Waters	28,910.00	42,565.00		13,655.00
Necropsies	1,350.00	2,519.00		1,169.00
Miscellaneous	11,748.00	172,477.00		160,729.00
Total	257,686.00	671,290.36		413,604.00
Serum section of the biological laboratory:				
Vaccine virus	21,800.22	28,875.55		7,075.33
Antirinderpest serum	1,190.78	757.15	₱433.63	
Mallein	591.50	245.70	345.80	
Miscellaneous sera and preparations	3,502.45	5,247.97		1,745.52
Total	27,084.95	35,126.37		8,041.42
Miscellaneous:				
Photographs	5,525.02	8,007.18		2,482.16
Natural history specimens	91.50	127.60		36.10
Shop orders	1,588.11	2,800.27		1,212.16
Miscellaneous work	1,607.74	622.56	985.18	
Supplies	3,018.17			
Sale of documents	7,452.06	6,364.71	1,087.35	
Refunded, work not done, etc. (deducted)	(109.22)	(137.00)		
Power, gas, etc	28,766.35	34,265.70		5,499.45
Reimbursement of traveling expenses etc.	4,131.50			
Total	52,071.23	52,051.02	20.21	
Grand total	389,228.25	797,890.29		408,662.04

[a] Included under organic chemistry.

TABLE III.—*Comparative table of cash receipts for the fiscal year 1913, as compared with the fiscal year 1912.*

[July 1, 1913.]

Division of the Bureau.	1912	1913	Decrease.	Increase.
General, inorganic, and physical chemistry:				
Metals and alloys	₱72.00	₱273.10		₱201.10
Rocks, minerals, natural pigments, and similar substances	79.00	20.00	₱59.00	
Clays, shales, limestones, limes, wall plasters, cements, and slags	738.44	265.50	472.94	
Fertilizers	108.30	108.00	0.30	
Soils and similar substances	731.00	35.00	696.00	
Coal analyses	138.00	173.00		35.00
Calorimetric tests of fuels	80.00	140.00		60.00
Waters	410.00	640.00		230.00
Crude chemical and miscellaneous analyses	236.80	306.40		69.60
Standard solutions	7.50	10.00		2.50
Physical tests of wire, twine, fibers, textiles, paper, and similar articles		157.00		157.00
Cements	6,738.80	9,129.05		2,390.25
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	368.50	268.00	100.50	
Standardization of road materials	110.50	415.50		305.00
Standardization of units of measures—				
Lengths		67.20		67.20
Capacities	13.00	4.00	9.00	
Weights	65.18	3.50	61.68	
Miscellaneous	103.22	10.80	92.42	
Total	10,000.24	12,026.05		2,025.81
Organic chemistry:				
Urines, clinical and toxicological analyses	1,381.00	1,513.00		132.00
Essential oils and essences	32.50	273.00		240.50
Petroleum and products, copra, and similar materials	78.00	177.50		99.50
Paints, varnishes, and linseed oils	229.75	327.50		97.75
Gums, resins, and similar materials	7.00	10.00		3.00
Gastric juice, clinical examinations	375.00	75.00	300.00	
Foods, alcohols, and beverages	1,838.00	914.50	923.50	
Food preservatives and coloring matters	5.00	14.00		9.00
Medicines and similar articles	73.00	93.00		20.00
Miscellaneous	409.50	96.00	313.50	
Total	4,428.75	3,493.50	935.25	
Mines: Assays	832.00	598.67	233.33	
Biological laboratory:				
Fæces	1,172.00	1,147.00	25.00	
Sputum	153.00	111.00	42.00	
Blood	2,184.00	2,816.00		632.00
Gonococci	6.00	18.00		12.00
Waters	480.00	750.00		270.00
Necropsies				
Miscellaneous	42.00	85.00		43.00
Total	4,037.00	4,927.00		890.00

TABLE III.—*Comparative table of cash receipts, etc.*—Continued.

Division of the Bureau.	1912	1913	Decrease.	Increase.
Serum section of the biological laboratory:				
Vaccine virus	₱21,800.22	₱28,876.55		₱7,076.33
Antirinderpest serum	1,190.78	757.15	₱433.63	
Mallein	591.50	245.70	345.80	
Miscellaneous sera and preparations	3,502.45	5,267.97		1,765.52
Total	27,084.95	35,147.37		8,062.42
Miscellaneous:				
Photographs	4,873.82	7,100.26		2,226.44
Natural history specimens	91.50	127.60		36.10
Shop work	419.95	207.20	212.75	
Miscellaneous work	1,607.74	622.56	985.18	
Supplies	3,018.17			
Sale of documents	7,452.06	6,364.71	1,087.35	
Refunded, work not done, etc. (deducted)	(109.22)	(137.00)		
Power, gas, etc	28,766.35	34,265.70		5,499.45
Reimbursement of traveling expenses etc	4,131.50			
Total	50,361.09	48,688.03	1,673.06	
Grand total	96,744.03	104,880.62		8,136.59

TABLE IV.—*Showing free and cash work performed and supplies manufactured and sold to the various departments of the Government and others for the fiscal year 1913.*

[July 1, 1913.]

Bureau or Department.	Samples or units.	Free.	Cash.	Total.
Bureau of Health:				
Urines, clinical and toxicological analyses	7,563	₱21,367.00	₱1,383.00	₱22,750.00
Petroleum and products, copra and similar materials	1	5.00		5.00
Paints, varnishes, and linseed oils	1	25.00		25.00
Gastric juice and clinical examinations	12	250.00	75.00	325.00
Foods, alcohols, and beverages	679	9,329.00		9,329.00
Food preservatives and coloring matters	15	100.00		100.00
Medicines and similar articles	31	330.00		330.00
Waters—				
Chemical	54	860.00		860.00
Biological	860	34,435.00		34,435.00
Fæces	10,456	78,839.00	925.00	79,764.00
Sputum	598	1,682.00	69.00	1,751.00
Blood	11,255	35,273.00	1,558.00	36,831.00
Gonococci	20,519	54,312.00	9.00	54,321.00
Necropsies	74	2,150.00		2,150.00
Miscellaneous biological work and examinations	57,170	170,785.00		170,785.00
Vaccine virus	2,405,115		28,042.41	28,042.41
Miscellaneous sera and preparations	1,644,205		3,166.36	3,166.36
Photographic work	1,387		1,538.43	1,538.43
Shop work	67		142.40	142.40
Total	4,160,112	409,742.00	36,908.60	446,650.60
Bureau of Public Works:				
Metals and alloys	1	4.00		4.00
Crude chemical and miscellaneous analyses	7		104.00	104.00
Cements	3,889		4,250.20	4,250.20
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	15		50.00	50.00
Standardization of road materials	20		200.50	200.50
Miscellaneous chemical analyses and examinations	1	2.50		2.50
Paints, varnishes, and linseed oils	1		9.00	9.00
Waters—				
Chemical	95	3,595.00		3,595.00
Biological	70	3,240.00		3,240.00
Photographic work	219		188.80	188.80
Total	4,318	6,841.50	4,802.50	11,644.00
Bureau of Supply:				
Metals and alloys	5	43.00		43.00
Rocks, minerals, natural pigments, and similar substances	1	10.00		10.00
Coal analyses	39	585.00		585.00
Calorimetric tests of fuels	23	460.00		460.00
Crude chemical and miscellaneous analyses	7	30.00	108.00	138.00

TABLE IV.—*Showing free and cash work performed, etc.*—Continued.

Bureau or Department.	Samples or units.	Free.	Cash.	Total.
Bureau of Supply—Continued.				
Physical tests of wire, twine, fibers, textiles, paper, and similar articles	27		₱106.00	₱106.00
Cements	5,379		3,564.00	3,564.00
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	13		52.00	52.00
Standardization of units of measure—				
Capacities	150	₱15.00		15.00
Weights	660	66.00		66.00
Lengths	96		67.20	67.20
Miscellaneous	202	2.50		2.50
Essential oils and essences	1	15.00		15.00
Petroleum and products, copra, and similar substances	20	140.00		140.00
Paints, varnishes, and linseed oils	27	15.00	178.50	193.50
Foods, alcohols, and beverages	13	96.00		96.00
Paper and similar materials	1	3.00		3.00
Medicines and similar articles	8	75.00		75.00
Miscellaneous biological work	2	20.00		20.00
Waters—				
Chemical	15	225.00		225.00
Biological	20	750.00		750.00
Miscellaneous sera and preparations	20,000		20.00	20.00
Total	26,709	2,550.50	4,095.70	6,646.20
Bureau of Science:				
Metals and alloys	5	88.50		88.50
Rocks, minerals, natural pigments, and similar substances	12	129.50		129.50
Clays, shales, limestones, limes, wall plasters, cements, and slags	21	354.00		354.00
Crude chemical and miscellaneous analyses	4	15.25		15.25
Standard solutions	7	35.00		35.00
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	3	3.00		3.00
Physical test of wire, twine, fibers, textiles, paper, and similar articles	1	4.00		4.00
Standardization of road materials	16	99.50		99.50
Petroleum and products, copra, and similar materials	10	187.50		187.50
Paints, varnishes, and linseed oils	3	26.00		26.00
Foods, alcohols, and beverages	127	1,270.00		1,270.00
Urine, clinical and toxicological analyses	1	3.00		3.00
Miscellaneous	19	35.00		35.00
Waters—				
Chemical	6	105.00		105.00
Biological	61	2,440.00		2,440.00
Blood	1	10.00		10.00
Photographic work	681	1,056.10		1,056.10
Assays	26	8.00		8.00
Shop orders	156	2,582.32		2,582.32
Total	1,160	8,451.67		8,451.67

TABLE IV.—*Showing free and cash work performed, etc.*—Continued.

Bureau or Department.	Samples or units.	Free.	Cash.	Total.
Bureau of Internal Revenue:				
Foods, alcohols, and beverages	15	₱375.00		₱375.00
Medicines and similar articles	135	665.00		665.00
Miscellaneous	2	20.00		20.00
Total	152	1,060.00		1,060.00
City of Manila:				
Crude chemical and miscellaneous analyses	2		₱45.40	45.40
Cements	15		50.00	50.00
Standardization of road materials	3		25.00	25.00
Medicines and similar articles	6		30.00	30.00
Miscellaneous biological work and examinations	1		25.00	25.00
Blood	2		225.00	225.00
Miscellaneous sera and preparations	141,000		141.00	141.00
Total	141.029		₱541.40	₱541.40
Provinces and municipalities:				
Cements	113		301.45	301.45
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	15		43.00	43.00
Standardization of road materials	10		114.00	114.00
Rocks, minerals, natural pigments, and similar substances	1		17.00	17.00
Soils and similar substances	1		5.00	5.00
Medicines and similar articles	4		5.00	5.00
Waters—				
Chemical	3		95.00	95.00
Biological	3		120.00	120.00
Vaccine virus	3,800		114.00	114.00
Miscellaneous sera and preparations	33,000		84.60	84.60
Total	36,950		899.05	899.05
Bureau of Printing:				
Paper and similar materials	99	1,200.00		1,200.00
Petroleum and products, copra, and similar materials	21	7.00		7.00
Assays	1	6.00		6.00
Photographic work	13		72.20	72.20
Total	134	1,206.00	72.20	1,278.20
United States Army and Navy:				
Metals and alloys	3		37.00	37.00
Cements	120		823.90	823.90
Standardization of road materials	1		5.00	5.00
Physical tests of wire, twine, fibers, textiles, paper, and similar articles	30		39.00	39.00
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	7		24.00	24.00
Clays, shales, limestones, limes, wall plasters, cements, and slags	2		10.00	10.00

TABLE IV.—*Showing free and cash work performed, etc.*—Continued.

Bureau or Department.	Samples or units.	Free.	Cash.	Total.
United States Army and Navy—Continued.				
Coal analyses	1		₱15.00	₱15.00
Standard solutions	3		10.00	10.00
Waters, chemical analyses	2		30.00	30.00
Petroleum and products, copra, and similar materials	9		133.00	133.00
Essential oils and essences	6		54.00	54.00
Foods, alcohols, and beverages	18	₱170.00	98.00	268.00
Medicines and similar articles	9		8.00	8.00
Miscellaneous analyses	11		82.00	82.00
Miscellaneous sera and preparations	573,608		887.30	887.30
Vaccine virus	14,064		478.90	478.90
Mallein	240		240.00	240.00
Photographic work	5		30.00	30.00
Total	588,139	170.00	300.10	3,175.10
Bureau of Agriculture:				
Antirinderpest serum	553,666.33		757.15	757.15
Mallein	37		3.70	3.70
Photographic work	278		85.60	85.60
Miscellaneous biological work	11	33.00		33.00
Total	553,992.33	33.00	846.45	879.45
Bureau of Justice:				
Medicines and similar articles	5		25.00	25.00
Blood	1		3.00	3.00
Total	6		28.00	28.00
Executive Bureau: Photographic work	1,338		502.90	502.90
Electrolysis Committee: Metals and alloys	5		63.60	63.60
Bureau of Lands:				
Soils and similar substances	5	150.00		150.00
Assays	1	2.00		2.00
Miscellaneous	1	20.00		20.00
Total	7	172.00		172.00
College of Medicine and Surgery, University of the Philippines:				
Urine, clinical and toxicological analyses	2	6.00		6.00
Photographic work	62		19.60	19.60
Shop work	1		0.61	0.61
Total	65	6.00	20.21	26.21
Bureau of Education:				
Physical tests of wire, twine, fibers, textiles, paper, and similar articles	3		12.00	12.00
Standardization of road materials	1		15.00	15.00
Paper and similar materials	6	18.00		18.00
Miscellaneous	6	30.00		30.00
Photographic work	2,108		584.40	584.40
Shop work	1		2.15	2.15
Total	2,125	48.00	613.55	661.55

TABLE IV.—*Showing free and cash work performed, etc.*—Continued.

Bureau or Department.	Samples or units.	Free.	Cash.	Total.
Bureau of Forestry:				
Coal analyses	1	₱15.00		₱15.00
Calorimetric test of fuels	1	20.00		20.00
Photographic work	263		₱52.20	52.20
Total	265	35.00	52.20	87.20
Bureau of Customs:				
Metals and alloys	7	49.00		49.00
Standardization of units of measure—				
Weights	7		3.50	3.50
Miscellaneous	8		0.80	0.80
Petroleum and products, copra, and similar materials	2	20.00		20.00
Paints, varnishes, and linseed oils	6	3.00	16.00	19.00
Gums, resins, and similar materials	1	10.00		10.00
Paper and similar materials	1	2.00		2.00
Foods, alcohols, and beverages	7	31.00		31.00
Medicines and similar articles	42	206.00		206.00
Soils and similar substances	3	9.00		9.00
Photographic work	16		35.50	35.50
Total	100	330.00	55.80	385.80
Bureau of Quarantine Service:				
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	2		14.00	14.00
Urine, clinical and toxicological analyses	3	7.00		7.00
Fæces	5,545	138,581.00		138,581.00
Sputum	2	6.00		6.00
Blood	2	6.00		6.00
Miscellaneous biological work and examinations	683	2,055.00		2,055.00
Vaccine virus	7,600		76.00	76.00
Total	13,837	140,655.00	90.00	140,745.00
University of the Philippines:				
Urine, clinical and toxicological analyses	5	15.00		15.00
Foods, alcohols, and beverages	9	90.00		90.00
Miscellaneous sera and preparations	34		2.00	2.00
Photographic work	651		386.66	386.66
Shop work	1		3.55	3.55
Miscellaneous biological work	4	9.00		9.00
Total	704	114.00	392.21	506.21
Bureau of Navigation:				
Coal analyses	1	15.00		15.00
Cements	1		5.00	5.00
Standardization of road materials	2		14.00	14.00
Petroleum and products, copra, and similar materials	1	7.00		7.00
Food preservatives and coloring matters	1	15.00		15.00
Waters, biological	5	200.00		200.00
Total	11	237.00	19.00	256.00

TABLE IV.—*Showing free and cash work performed, etc.*—Continued.

Bureau or Department.	Samples or units.	Free.	Cash.	Total.
Philippine Constabulary:				
Fæces	5	₱37.00		₱37.00
Sputum	11	24.00		24.00
Blood	3	153.00		153.00
Physical tests of wire, twine, fibers, textiles, paper, and similar articles	2		₱8.00	8.00
Vaccine virus	34		0.34	0.34
Total	55	214.00	8.34	222.34
Bureau of Prisons:				
Urine, clinical and toxicological analyses	2,024	6,072.00		6,072.00
Foods, alcohols, and beverages	1	3.00		3.00
Miscellaneous chemical analyses and examinations	5	5.00		5.00
Waters, biological	34	750.00		750.00
Miscellaneous biological work and examinations	108	241.00		241.00
Fæces	18,452	55,730.00		55,730.00
Sputum	5,155	15,465.00		15,465.00
Blood	14,169	42,528.00		42,528.00
Necropsies	13	350.00		350.00
Total	39,961	121,144.00		121,144.00
Philippine Exposition: Photographic work	242		48.40	48.40
Philippine Library: Photographic work	60		13.80	13.80
The Sales Agency: Photographic work	12		2.40	2.40
Consulting Architect: Photographic work	24		17.70	17.70
Weather Bureau: Photographic work	62		12.40	12.40
Miscellaneous:				
Metals and alloys	19		172.50	172.50
Rocks, minerals, natural pigments, and similar substances	1		3.00	3.00
Clays, shales, limestones, limes, wall plasters, cements, and slags	31		255.50	255.50
Fertilizers	11		108.00	108.00
Soils and similar substances	2		30.00	30.00
Coal analyses	16		158.00	158.00
Calorimetric tests of fuels	7		140.00	140.00
Crude chemical and miscellaneous analyses	5		49.00	49.00
Cements	38		134.50	134.50
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	6		85.00	85.00
Standardization of road materials	7		42.00	42.00
Standardization of units of measure—				
Capacities	4		4.00	4.00
Miscellaneous	5		10.00	10.00
Urine, clinical and toxicological analyses	47		130.00	130.00
Essential oils and essences	30		219.00	219.00
Petroleum and products, copra, and similar materials	7		44.50	44.50
Paints, varnishes, and linseed oils	9		124.00	124.00

TABLE IV.—*Showing free and cash work performed, etc.*—Continued.

Bureau or Department.	Samples or units.	Free.	Cash.	Total.
Miscellaneous—Continued.				
Foods, alcohols, and beverages	166		₱816.50	₱816.50
Food preservatives and coloring matters	3		14.00	14.00
Medicines and similar articles	3		25.00	25.00
Gums, resins, and similar materials	2		10.00	10.00
Miscellaneous chemical analyses and examinations	14		96.00	96.00
Assays	279		598.67	598.67
Waters—				
Chemical	19		515.00	515.00
Biological	17		630.00	630.00
Fæces	72		222.00	222.00
Sputum	14		42.00	42.00
Blood	108		1,030.00	1,030.00
Gonococci	3		9.00	9.00
Miscellaneous biological work and examinations	8		60.00	60.00
Vaccine virus	3,174		163.90	163.90
Mallein	2		2.00	2.00
Miscellaneous sera and preparations	406,638		986.71	986.71
Photographic work	7,077		3,360.09	3,360.09
Natural history specimens	84		127.60	127.60
Shop work	24		58.49	58.49
Miscellaneous work	34		152.14	152.14
Sales of publications			6,364.71	6,364.71
Power, gas, etc			34,265.70	34,265.70
Reimbursement of traveling expenses etc			393.60	393.60
Refunded, work not done, etc			137.00	137.00
Total	418,604		51,769.11	51,769.11
Grand total	5,990,178.33	₱693,909.67	104,880.62	797,890.29

TABLE V.—*Comparative statement showing expenditures (including obligations incurred) for the fiscal year 1913 as compared with the fiscal year 1912.*

Item.	Expended during the year.	Outstanding obligations on July 1, incurred during the fiscal year.	Total for the fiscal year 1913.	Total for the fiscal year 1912.	Decrease.	Increase.
Apparatus, supplies, etc.:						
Miscellaneous supplies and chemicals	₱17, 189. 27	₱6, 419. 52	₱23, 608. 79	₱30, 331. 31	₱6, 722. 52	
Apparatus	4, 430. 87	12, 047. 84	16, 478. 71	18, 486. 77	2, 008. 06	
Supplies for power plant, oil, coal, etc	27, 722. 84	13, 343. 01	41, 065. 85	27, 913. 31		₱13, 152. 54
Small animals, feed, etc	2, 012. 39		2, 012. 39	3, 620. 28	1, 607. 89	
Large animals, feed, etc	4, 231. 49		4, 231. 49	3, 754. 15		477. 34
Office supplies	3, 832. 58	86. 93	3, 919. 51	2, 545. 02		1, 374. 49
Photographic supplies	3, 672. 46	162. 43	3, 834. 89	2, 471. 28		1, 363. 61
Books, subscriptions, etc	8, 216. 35	4, 560. 73	12, 777. 08	10, 524. 94		2, 252. 14
Total	71, 308. 25	36, 620. 46	107, 928. 71	99, 647. 06		8, 281. 65
Transportation and freight, etc.:						
Transportation, travel expenses, per diems, launch hire, etc	13, 421. 20		13, 421. 20	16, 303. 82	2, 882. 62	
City transportation	2, 175. 15		2, 175. 15	3, 236. 86	1, 061. 71	
Freight	1, 134. 66		1, 134. 66	885. 14		249. 52
Total	16, 731. 01		16, 731. 01	20, 425. 82	3, 694. 81	
Miscellaneous:						
Telephones and fire alarm boxes	1, 518. 09		1, 518. 09	977. 54		540. 55
Postage, telegrams, and cablegrams	3, 181. 79		3, 181. 79	2, 541. 64		640. 15
Repairs to apparatus, furniture, etc	828. 94		828. 94	1, 183. 07	354. 13	
Laundry	423. 21		423. 21	410. 00		13, 21
Printing and binding	26, 024. 49	11, 224. 90	37, 249. 39	35, 000. 61		2, 248. 78
Advertising	931. 04		931. 04	961. 94	30. 90	
Incidentals, building maintenance, etc	2, 075. 25		2, 075. 25	14, 234. 90	12, 159. 65	
Museum specimens	4, 207. 94	100. 00	4, 307. 94	440. 10		3, 867. 84
Total	39, 190. 75	11, 324. 90	50, 515. 65	55, 749. 80	5, 234. 15	

TABLE V.—*Comparative statement showing expenditures, etc.*—Continued.

Item.	Expended during the year.	Outstanding obligations on July 1, incurred during the fiscal year.	Total for the fiscal year 1913.	Total for the fiscal year 1912.	Decrease.	Increase.
Salaries and wages:						
Salaries and wages	₱234,083.11		₱234,083.11	₱250,099.14	₱16,016.03	
Transportation and expenses en route foreign country to Manila	3,508.35		3,508.35	3,141.21		₱367.14
Accrued leave and half salary	20,536.28		20,536.28	19,520.12		1,016.16
Total	258,127.74		258,127.74	272,760.47	14,632.73	
Grand total	385,357.75	₱47,945.36	433,303.11	448,583.15	15,280.04	
The outstanding obligations and accounts payable of previous fiscal year unpaid on July 1, 1912, amounted to ₱79,001.23. During the fiscal year 1913, ₱69,776.87 was paid against this amount and the difference between estimates and actual costs and cancellations amounted to ₱5,102.48, leaving the obligations still due on previous fiscal years, ₱14,326.84	69,776.87	14,326.84	Appropriation account:			
			Allotment, fiscal year 1913			₱340,000.00
			Accounts payable, fiscal year 1912			23,499.60
	455,134.62	62,272.20	Brought forward from previous fiscal year to cover contingent obligations			43,684.70
Public works: Alterations to boilers, section 4, Act 1989:			Receipts from operation			104,880.62
Available, Feb. 12, 1913	8,500.00		Restoration, section 4, Act 1989			2,700.00
Expended			Total			514,764.92
Balance	8,500.00					
Aquarium, section 4, Acts 1902 and 1989:			Expended, as shown above		₱455,134.62	
Available, July 1, 1912	18,899.91		Outstanding obligations		62,272.20	
Expended	16,690.28		Credit		(2,641.90)	514,764.92
Balance	2,209.63		Balance			
Library equipment, Act. 1988:			Library fund, Act 1416:			
Available, July 1, 1912	2,206.39		Available, July 1, 1912			4.44
Expended	528.31		Expended			4.44
Balance	1,624.08		Balance			

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THE PHILIPPINE JOURNAL OF SCIENCE

ALVIN J. COX, M. A., PH. D.

GENERAL EDITOR

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Thirteenth Annual Report of the Director of the Bureau of Science

Philippine Islands

TO THE HONORABLE
THE SECRETARY OF THE INTERIOR

BY

ALVIN J. COX
DIRECTOR OF THE BUREAU OF SCIENCE

FOR THE YEAR ENDING
DECEMBER 31, 1914

INCLUDING ESSENTIAL INFORMATION CONCERNING THE
SIX MONTHS ENDED DECEMBER 31, 1913

MANILA
BUREAU OF PRINTING
1915

137169

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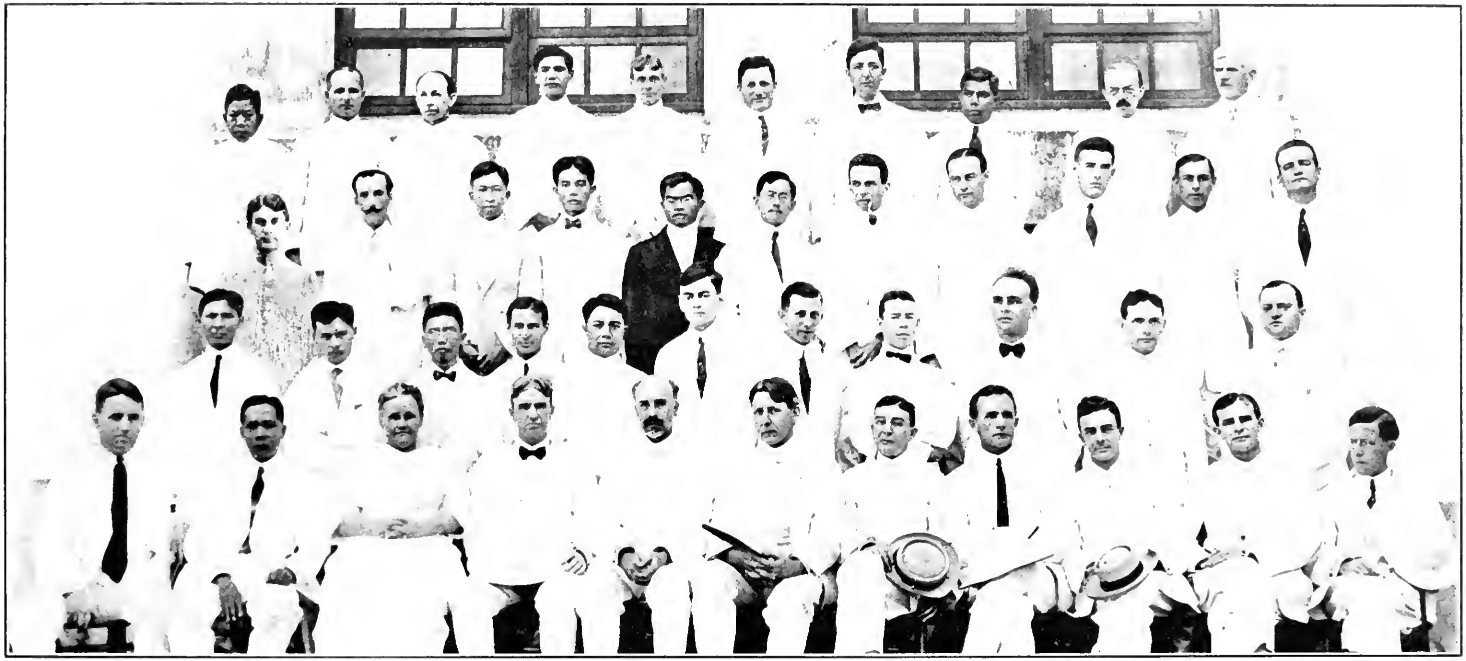
[1] Appointment effective, June 20, 1915.
[2] Appointment effective, August 1, 1915.
[3] Appointment effective, August 14, 1915.
[4] Appointment effective, January 1, 1915.



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Thirteenth Annual Report of the Director of the Bureau of Science

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THIRTEENTH ANNUAL REPORT OF THE DIRECTOR OF THE BUREAU OF SCIENCE

THE GOVERNMENT OF THE PHILIPPINE ISLANDS,
DEPARTMENT OF THE INTERIOR,
BUREAU OF SCIENCE,
Manila, January 1, 1915.

SIR: I have the honor to submit the following general statement of the work carried on in the Bureau of Science from July 1, 1913, to December 31, 1914, together with a few recommendations with regard to improvements and extension of the work which seem to me advisable. Since the calendar year 1914 is the first full fiscal year since the Philippine Legislature passed Act No. 2305 which changed the fiscal year to conform with the calendar year, I have included in this report an account of the work carried on in the Bureau of Science for the preceding six months, which has not been covered by any published report.

The Bureau of Science during its many years of existence has become very widely known all over the world. We have in the Philippines what the Britanica Year Book of 1913 in a biography of Dr. Paul C. Freer, late director of the Bureau of Science, calls "a great research institution that is now classed with the best in the world." The Bureau of Science has always been composed of capable and energetic men who have had a clear conception of what is to be accomplished, and the routine work of the institution, which has greatly increased throughout the last years, has been performed not as a goal in itself, but as a necessary part of the great work which must be achieved. A great volume of correspondence carried on in the name of the Bureau of Science by our various division chiefs and the Director has announced the accomplishments of the Government of the Philippine Islands in all parts of the globe, and has given to the Philippine Islands the benefit of extensive research carried on in other countries. Repeatedly the members of the staff of the Bureau of Science have taken a leading part in scientific conferences at which many great nations were represented. Frequently letters come to us from both friends and persons unknown to us in appreciation of the quality of the scientific work of this Bureau and the way in which we are publishing it.

During the period covered by this report a determined effort has been made by individuals who apparently have little knowl-

edge of the Bureau of Science or the work to be performed by it to annex the Bureau along with the Philippine General Hospital to the University of the Philippines. When this plan failed, an attempt was made to unite the Bureaus of Science, of Forestry, and of Agriculture, and the College of Engineering of the University of the Philippines with the College of Agriculture of the University of the Philippines situated at Los Baños, three hours distant from Manila by train. All of the reasons which I have seen advanced for this combination are general statements unsupported by figures or evidence. As far as I am aware, persons most familiar with the situation have been much opposed to, and have discouraged, the efforts to combine activities so distinct as those of the institutions above mentioned. After an investigation by the Legislature, the question of uniting these institutions, as far as the Bureau of Science is concerned, has now been dropped. The Honorable, the Secretary of the Interior has carefully studied the operations of the Bureau of Science and has expressed himself as exceedingly pleased with its operations as shown by his letter of July 11, 1914, copies of which were given to the press.

THE UNITED STATES DEPARTMENT OF AGRICULTURE FOLLOWS THE EXAMPLE OF THE BUREAU OF SCIENCE

Previous to 1906 the Bureau of Science issued free a series of 36 bulletins and many other similar publications. It was recognized by the late Director of the Bureau of Science, as well as by many of his colleagues and by other scientific men, that a high-grade character could not be maintained in the Bureau publications when issued in this way, and in 1906 the Bureau ceased publishing its material in the form of bulletins and started the Philippine Journal of Science. The arrangement has been eminently satisfactory. A subscription price was charged to prevent waste and miscellaneous distribution and to effect economy, but the Journal has been sent to the leading scientific institutions in exchange for their publications which have become valuable additions to our library.

An article in Science of August 8, 1913, entitled "Publications of the Department of Agriculture" [Washington, U. S. A.], shows that the Department of Agriculture plans to follow the example of the Bureau of Science. It reads as follows:

> The Secretary of Agriculture has announced new plans of publication work for that department. There has been an independent series of bulletins and circulars in each of the thirteen publishing bureaus, divisions and offices of the department. These have been discontinued and will be

superseded by the Journal of Research for printing scientific and technical matter, and by a departmental series of bulletins, written in popular language for selected and general distribution. By this plan the confusion that has resulted from the multiplicity of series of publications will be avoided, and the saving of a considerable sum will annually be effected * * *.

The highly scientific matter heretofore published indiscriminately in bulletins and circulars will hereafter be published only in the newly established *Journal of Research*, which will be issued about once a month * * *.

The Journal will be distributed free to agricultural colleges, technical schools, experiment stations, libraries of large universities and certain government depositories and institutions making suitable exchanges; also to a restricted list of scientific men. Copies of the Journal will be sold to miscellaneous applicants by the superintendent of documents, Government Printing Office, * * *.

The new plan of publication work has been designed primarily to improve the character of the department's publications, and secondarily to prevent waste in distribution, and through the economies effected, a greater output of information will become possible with the available appropriation * * *.

UTILIZATION OF RESULTS BY THE BUREAU OF HEALTH

A noteworthy thing in the Annual Report of the Director of Health of the Philippine Islands for the fiscal year ending June 30, 1913, is the record of the extent to which the results of work of the Bureau of Science have been utilized by the Bureau of Health. The following instances quoted from my memorandum report of December 31, 1913, indicate the extent to which the routine work and researches of the Bureau of Science have contributed to the improved health conditions of the Islands, and show a few of the ways in which this work has been put into practical use.

A pamphlet entitled Insects and Diseases is used in public schools and will, no doubt, do much good in disseminating such information as that malarial fever is conveyed by definite kinds of mosquitoes, that filariasis is transmitted by another, etc. During the fiscal year 1913 the Bureau of Science examined 23,450 samples of blood for malarial parasites and similar organisms, and during the last six months the scope of this work has been extended.

The Bureau of Health circular formerly issued on dysentery has been revised and rewritten, and its provisions now correspond with the more recent study made by the Bureau of Science in the prevention of this disease. The work of Doctor Walker of this Bureau upon amœbic dysentery is epoch making. Another pamphlet was prepared on beriberi which has awakened the public to the fact that beriberi occurs among those who use polished rice as a staple article of diet. The work of Doctors Strong and Crowell and of Mr. Williams, of the Bureau of Science, and of others, including the United States Army Board for the study of Tropical Diseases as They Exist in the Philippine Islands, here manifests itself. An illustrated pamphlet on The poisonous fishes of the Philippines, which has

been issued by the Bureau of Health, was written by Mr. Seale of the section of ichthyology of the Bureau of Science.

The diagnostic work connected with the examinations for communicable diseases referred to on page 11 of the report of the Director of Health in the regulation of dance halls is carried on by the Bureau of Science. During the last fiscal year we examined 20,522 samples for gonococci.

The Manila milk supply is referred to on page 14. All of the native as well as imported milks are inspected and analyzed in the Bureau of Science, and a comprehensive investigation of the milk of the carabao by Mr. Dovey, of the chemical laboratory of the Bureau of Science, has been published. A tabulation of the composition of cows' milk imported into the Philippine Islands, sterilized milk, condensed milk, fat-free condensed milk, and other forms of milk by Mr. Agcaoili, of the Bureau of Science, has been published.

On pages 16, 35, 65, etc., the food and drug inspection is mentioned. The Food and Drugs Board of the Philippine Islands is a body appointed by the Governor-General, and consists of the Assistant Director of Health, the chief of the division of organic chemistry of the Bureau of Science, the chief appraiser of the port of the Bureau of Customs, and the chief city agent of the Bureau of Internal Revenue. This board is advisory to the Director of Health. All the work accomplished by this Board, whether prosecutions or the issuing of decisions relative to food and drugs found upon the market or imported into the Philippine Islands, originates in the Bureau of Science where all analytical work necessary for the enforcement of the Food and Drugs Act and for the examination of food and drink for sale in Manila is carried on.

On page 24 is mentioned the Maritime Quarantine which inspects immigrants for hookworm, intestinal parasites, amœbic dysentery, and even balantidic dysentery, cholera, etc. All of these diagnostic examinations are made by the Bureau of Science. During the last fiscal year we examined 34,530 samples of fæces in connection with this work, and for the period covered by this report the number has exceeded 24,000.

On page 25 the experimental work of the sterilization of water by the ultra-violet rays is mentioned. The idea originated in the Bureau of Science, the apparatus is now being installed in the Bureau of Science, and the work will be carried on and the apparatus operated by the Bureau of Science employees.

The character of the milk importation mentioned on page 26 is greatly improved, owing to the inspection carried on in the division of organic chemistry of the Bureau of Science which does the food and drug analyses.

Mosquito work mentioned on page 27 originated in the Bureau of Science, and this Bureau supplied the information necessary for the inspectors in carrying out the routine work.

Mineral waters of the Philippine Islands are mentioned on page 31 as follows:

The last Legislature by Act No. 2264, made available the sum of ₱15,000 for the purpose of studying the mineral waters of the Philippine Islands and at this writing the work is under way. Samples of water have already been secured and analyzed from all small springs known to the Bureau, and records and descriptions, real or alleged, of the properties of the waters are now being collected.

All of these analyses were made by the chemists of the Bureau of Science.

On page 43 the fly menace is mentioned. Whenever an epidemic of

flies becomes very severe, the Bureau of Science is called upon to act and promulgate measures to abate the nuisance.

Regarding plague mentioned on page 51, all the examinations of rats are made in the Bureau of Science; nearly 60,000 were examined during the fiscal year 1913, and the work has been continued at about the same rate.

The vaccines and sera used by the Bureau of Health are manufactured and furnished by the Bureau of Science.

On page 93 health conditions at Baguio are discussed. Much work was done by members of the Bureau of Science in investigations in Baguio, tending to improve the health conditions. Concerning bacillary dysentery, much work has been done by Doctor Barber in Baguio.

With regard to cholera mentioned on pages 110 and 111, all the laboratory examinations were made by the Bureau of Science.

Much work referring to yaws discussed on page 131 has been done in the Bureau of Science. In fact, the Bureau of Science demonstrated that salvarsan was effective in the treatment of the spirochæte giving rise to yaws and that in the severe cases the disappearance of the lesions and the cures produced were almost marvelous.

FAR EASTERN ASSOCIATION OF TROPICAL MEDICINE

Dr. E. L. Walker, of this Bureau, was appointed by His Excellency, the Governor-General, as one of the delegates from the Philippine Islands to the third biennial congress of the Far Eastern Association of Tropical Medicine, in Saigon from November 8 to 15, 1913. The congress, like the previous ones, was well attended, and various tropical diseases were discussed. The stimulus of thought and the benefit derived from an organization of this kind is very great, not only to the delegates, but also to the institutions which they represent, especially in this part of the world where the scientific work is isolated to a great extent. The papers which were read treated of a great variety of subjects—dysenteries of different etiology, cholera, typhoid, plague, leprosy, animal parasites and parasitic diseases, beriberi, and tropical medicine and sanitation.

PHILIPPINE ISLANDS MEDICAL ASSOCIATION

The fourth annual meeting of the Philippine Islands Medical Association was held in Manila between the dates of November 5 and 7, 1914. The Bureau of Science was represented on the standing committees in scientific work, public policy and legislation, and exhibits. Important papers were read by Bureau of Science representatives on cholera, malaria, beriberi, leprosy, and the germicidal action of glycerol.

COMMITTEE ON STANDARDIZATION OF SUPPLIES

For several years the Bureau of Science has been endeavoring to create an interest in the subject of the standardization of supplies for Government use, and for some time all supplies

such as khaki, rain coats, hats, and string, purchased for the Bureau of Constabulary, have been upon the basis of specification. I referred to the standardization of material purchased by the Government in my annual report for the fiscal year 1912, pages 2, 25, 26, 27, 50, 51, and 52, and in my annual report for the fiscal year 1913, pages 73 and 74. In each instance a remarkable increase in the quality has been noted after the purchase of supplies under specification has been thoroughly initiated, and this improvement in quality is usually secured without an increase of original cost. In the testing of materials and supplies, the Government of the Philippine Islands is far behind other progressive countries. The successful solution of many of our local problems concerning material for construction must be solved by local research, as available information on many of these subjects is meager and only a few general results are applicable to the Philippines. For example, protective coatings, paints, asphalts, dust preventatives, and iron and steel may give good service in some climates, but prove unsatisfactory in the tropics. In time, results obtained by studying the physical and chemical properties of various products, and materials in connection with their efficiency in actual service, will be of great value. From time to time I have pointed out the necessity for a new testing laboratory and an increase in our force and equipment. At the present time we perform, as well as we can with our equipment, physical tests of a great many materials, such as cement and other similar materials, concrete, mortar, building blocks, bricks, stones, reënforcing iron, steel, cloth, rope, wire, road material, and ties. On June 24, 1914, His Excellency, the Governor-General, issued Executive Order No. 62, which is as follows:

> E. G. Shields, Purchasing Agent; Warwick Greene, Director of Public Works; and Alvin J. Cox, Director of Science, are hereby constituted a permanent committee to be known as the Committee on Standardization of Supplies.
>
> It shall be the duty of the committee thus constituted, after studying the requirements of the various branches of the service, to establish certain makes, grades, qualities, or kinds of material and equipment as the standards of their class to be furnished for Government use.
>
> After the standards of any classes of material or equipment have thus been established, the Purchasing Agent shall furnish no others upon requisitions unless (1) specifically authorized by the Governor-General, (2) sanctioned by subsequent action of the committee, or (3) to admit of the disposal of material and equipment already on hand.

This is in reality an economic measure. The committee has collected specifications enforced in many places and has held one

meeting at which it was determined that an effort would be made first to eliminate the inferior material and to systematize and classify office supplies. This work will proceed slowly, because in most instances it is necessary to devise special methods of analysis in order to select materials best suited to our needs.

MANUFACTURE OF EXTRACT OF TIQUI-TIQUI

Under the provisions of Act No. 2376 the Bureau of Science is charged with the duty of preparing extract of tiqui-tiqui for the experimental treatment of infantile beriberi. The actual work of preparing this extract has been under the supervision of the chief of the division of general, inorganic, and physical chemistry, who has modified and improved the methods of preparation. This work is of great practical importance, a view which we believe will be fully borne out by the report of the committee created by Act No. 2376 to supervise the distribution of the remedy and to collect the statistical evidence relating thereto. Up to the close of the year, in spite of some untoward circumstances, such as a fire in June which burned the products under preparation, 58 liters of extract have been prepared, probably sufficient to treat 700 infants.

REDUCTION OF STAFF

The uncertainty due to pending legislation in the United States with regard to the Philippine Islands has led many employees of the Philippine Government to seek employment elsewhere, and there has been a larger number of resignations from the Bureau of Science than usual. On August 22, 1914, his Excellency, the Governor-General, issued the following order:

To all Chiefs of Bureaus and Offices:

On account of the situation arising from the European war, there is urgent necessity for renewed efforts toward economy * * *. It is directed that every effort at economy be now put forth, and to this end no positions now vacant should be filled; no promotions in the service should be made; and no purchases of supplies, except such as are imperatively required, should be made * * *.

The many resignations and the impossibility of filling vacancies has reduced the staff to such an extent that the work of the Bureau of Science has suffered seriously.

APPOINTMENT OF A DIRECTOR

The Assistant Director, who was appointed Acting Director in May, 1912, following the death of Dr. Paul C. Freer on April 17, 1912, and who has continued to direct the affairs of the

Bureau since that date, was appointed Director, Bureau of Science, on January 22, 1914.

The work of the Bureau has continued along the lines outlined in my preceding reports, so it seems unnecessary to go into details in this report. Miscellaneous questions will be treated under the discussion of the department of the Bureau to which they chiefly refer. However, I desire especially to express my appreciation of the coöperation and the devotion to their work of our scientists, who have made possible our great accomplishments in the face of many adverse circumstances.

BIOLOGICAL LABORATORY

Personnel.--Dr. E. L. Walker, chief of the biological laboratory, who went on leave in June, 1914, has resigned to accept a position as associate professor of tropical diseases in the Hooper Institute at San Francisco, and Dr. M. A. Barber has been promoted to his place. Dr. D. G. Willets, who went on leave in December, 1913, resigned to accept a position as technical assistant in the United States Public Health Service. Mr. Ariston M. Guzman returned from leave in the United States on July 21, 1914. The position rendered vacant by the resignation of Mr. Porter D. Leaky in the Philippine General Hospital laboratory was filled by the assignment of Mr. Theodore Bolanes, an assistant in the routine laboratory. The resignation of Mr. Bolanes was accepted on August 4, 1914, and Mr. L. D. McMillan was dropped owing to legislative action. A temporary assistant who resigned has not been replaced. Dr. Liborio Gomez was transferred to the Bureau of Constabulary in August, 1913, and Dr. J. D. Jungmann was appointed as assistant in the laboratory and assumed his duties in the same month. The latter was assigned to duty in the clinical laboratory of the Philippine General Hospital. One routine assistant was summarily dismissed for cause.

ROUTINE WORK

Owing to resignations, the courses heretofore given by members of the staff on protozoölogy and medical entomology in the College of Medicine and Surgery of the University of the Philippines are no longer conducted. At present the scheduled course on immunity is given in the Graduate School of Tropical Medicine and Public Health.

The outbreak of cholera caused a large increase in the amount of work performed in the routine laboratory and necessitated the employment of additional assistants. The Bureau has had the services of Hospital Sergeant Edward Theurick, United

States Army, and First Class Hospital Apprentice Hugh Lane, United States Navy.

Since September the Philippine General Hospital has undertaken to perform its own laboratory work, and in consequence the routine examinations have been reduced in number along certain lines. Since August 3 Bilibid Prison has also been handling most of the routine work there. These reductions have been more than offset by the extra number of examinations entailed by the presence of cholera. Four men were constantly employed on this duty, and much overtime work was carefully and faithfully performed. During the flood in September, when practically all transportation was suspended, a sufficient number of the staff were on duty and the examinations for cholera went on uninterruptedly, a fact which speaks well for the esprit du corps.

The war in Europe has interfered with our source of supplies, and the laboratory has had great difficulty in securing sufficient bacteriological glassware for the cholera work. The Department Surgeon, United States Army, very kindly furnished such supplies as he had; and although very much restricted and hampered, up to this date we have been able to take care of all important work without much delay. The routine clinical, bacteriological, and pathological examinations have continued to increase, and those made during the fiscal year 1913, the six months from July 1 to December 31, 1913, and the calendar year 1914 are given in parallel columns in the following table:

Nature of examination.	Twelve months ended June 30, 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.
Fæces	24,530	24,502	126,022
Sputum	5,770	1,919	2,095
Blood	23,450	8,780	6,398
Blood culture	226	185	392
Widal test	388	316	599
Wassermann test	727	798	1,288
Leprosy	848	243	1,142
Urine	6,974	5,309	4,275
Gonococci	20,522	8,541	16,383
Water	1,077	1,211	2,118
Autopsy	130	142	412
Histological examination	606	322	181
Rabies	11	14	35
Plague	45	13	64
Rats for plague	(a)	27,564	113,337
Miscellaneous	57,916	796	1,649
Total	153,220	80,655	276,390

[a] Included under miscellaneous.

INVESTIGATION

So much of the time of the staff has of necessity been required for routine examinations that only one man has been regularly engaged in research work. Nevertheless considerable important work has been accomplished.

Every piece of research that is intelligently chosen and is prosecuted by a capable investigator must contribute to our scientific knowledge. Although the practical importance of the results as measured by pesos or human lives may not be immediately apparent, they may later prove to be of vast benefit to mankind. The discovery by Theobald Smith in 1892 that Texas tick fever was transmitted by the bite of the cattle tick may not have appeared at that time to be of great practical importance; yet it disclosed the principle of the insect transmission of tropical diseases, which has enabled medical science to control malaria, yellow fever, and other diseases, and has rendered possible the construction of the Panama Canal, which had failed previously on account of the great mortality from these diseases in the Canal Zone.

All of the enumerated researches carried on in the biological laboratory during the period covered by this report have practical results which are immediately apparent. Investigations in progress include the following:

Cholera.—An interesting series of studies as to the viability of *B. choleræ* in water under ordinary conditions of light and temperature is being carried on. Another investigation deals with the irritability of the cholera bacillus under certain conditions.

Malaria.—An experimental determination of the distribution and the species of the mosquitoes capable of transmitting malaria in the Philippines is in progress. Several species have been definitely identified as "carriers," and the result of this work will contribute greatly to the sanitary improvement of these Islands, and will afford a great financial saving in any campaign against malaria. The health authorities of the Canal Zone estimated that from $150,000 to $200,000 were saved in their malaria campaign by the discovery that a certain anopheles mosquito that bred in the hollows of rotten stumps could not transmit malaria.

Tuberculosis.—Experiments on tuberculosis which were previously reported have been continued.

Leprosy.—The investigation on leprosy previously reported is still being carried on, and studies on the cultivation of *B. lepræ*

have yielded promising results. In connection with the division of organic chemistry an investigation is now being conducted with a view to obtaining an active principle from chaulmoogra oil. Dr. John A. Johnston, of this Bureau, was appointed by the Secretary of the Interior as chairman of a committee to investigate a treatment for leprosy, and this work is still in progress.

Plague.—The routine work during the calendar year in examining 113,337 rats for plague has been enormous, and some facts previously unknown have been discovered. The routine examinations have served to confirm previous investigations of this laboratory with regard to plague.

Pathology.—The pathologist has performed 412 autopsies during the calendar year, mostly as diagnostic measures for the Bureau of Health. These have included such diseases as Asiatic cholera, bubonic plague, beriberi, malaria, tuberculosis, glanders, entamœbic and bacillary dysenteries, leprosy, diphtheria, tetanus, various tumors, and cases of trauma. Pathological specimens from the Philippine General Hospital, Bureau of Health, and from physicians in private practice to the number of 609 have been examined.

Sera and vaccines.—The following preparations were kept in stock and prepared in quantities sufficient to meet the demand: Antirinderpest serum, antidiphtheritic serum, antitetanic serum, anticholera serum, antiplague serum, antistreptococcic serum, serum for exophthalmic goitre, and normal horse serum. Other normal sera were furnished on request. In November, 1913, antimeningococcic serum was added to the list. Variola vaccine, mallein, plague vaccine, cholera vaccine, gonococcus vaccine, staphylococcus vaccine, typhoid vaccine, streptococcus vaccine, dysentery vaccine, anthrax vaccine, *B. coli* vaccine, tuberculin, and autogenous vaccines were furnished on request.

From July 1, 1913, to December 31, 1914, inclusive, 1,882 serum tests for syphilis were made and 398 specimens of blood were examined bacteriologically.

Rabies.—The work on rabies was continued and 163 patients received the Pasteur treatment.

ULTRA-VIOLET RAYS WATER-STERILIZING APPARATUS

The Bureau of Science purchased for the city of Manila a plant, consisting of one ultra-violet rays water-sterilizing apparatus type C–3, complete, with automatic valve and lamp and one rotary converter, with variable speed 110-volt direct current motor and generator field regulation, to deliver direct current

with a range of from 50 to 250 volts. After many vexatious delays, the installation is now completed. The plant is of sufficient size to give results comparable with those of commercial procedure. In 1911 this Bureau placed a small ultra-violet light and quartz tube and working space in the Bureau at the disposal of the members of the United States Army Board for the Study of Tropical Diseases as they exist in the Philippine Islands. These gentlemen submitted amœbæ in the quartz tube to the effect of the ultra-violet rays, and the results of their experiments as published in the Philippine Journal of Science, Sec. B (1911), **6**, 383–94, are very satisfactory. The city of Manila desired that we continue this work on a commercial scale. It is probable, however, that the sterilizing plant will not eliminate bacteria entirely from unfiltered water, and recent experiments by Doctor Walker tend to prove that the amœbæ ordinarily found in water supplies are not injurious.

SECTION OF BOTANY OF THE BIOLOGICAL LABORATORY

Personnel.—The only changes in the personnel of the botanical section were those caused by the death of Dr. C. B. Robinson and the resignation of Mr. Paul W. Graff.

Doctor Robinson was murdered by the natives of Amboina on December 5, 1913, the first news reaching Manila on the 23d of the same month. The details of his death are already known to you, and it is certain that his unfortunate murder was entirely due to superstitious fear on the part of the natives who accomplished the deed. The guilty parties were soon apprehended by the Dutch authorities, and have been tried, found guilty, and sentenced. Doctor Robinson was one of our most capable, energetic, resourceful, and efficient men. His loss is a severe one to science as well as to this Bureau. As soon as possible after the news of this sad occurrence reached us, Mr. Merrill left for Buitenzorg, Java, in January, 1914, there to receive the botanical collections made by Doctor Robinson. All the collections were preserved, received in excellent condition, and brought to Manila, where the specimens have been arranged for study.

Mr. Graff's resignation was accepted at the end of his two years' contract, but he was retained as a temporary employee until the end of the school year because he had charge of one class in botany in the University. Mr. Graff left the service on May 14, 1914. Owing to lack of funds the position has not been filled in spite of the fact that the continuation of the mycological work is urgent. There are now only two botanists in

the Bureau: namely, Mr. E. D. Merrill, chief botanist, and Dr. W. H. Brown, assistant botanist. With this depleted force the amount of scientific and economic work is more than commensurate with what was being done a year ago.

Routine work.—Mr. Merrill has continued, as in the preceding year, as associate professor of botany and acting chief of the department of botany in the University of the Philippines. Instruction has been given to a total of about 90 students in five courses; two of the courses have been under the personal direction of Mr. Merrill. Although he is detailed to the University for half time, during the present semester he actually spends in class work as many hours as full-time men. The depletion of the botanical force in the Bureau of Science made it necessary for Mr. Merrill to take over extra University work—work for which Mr. Graff of this Bureau was detailed last year—and thus to spend a large amount of time that could have been devoted profitably to botanical investigation. In addition to his work in the College of Liberal Arts, Mr. Merrill has also given a series of 10 lectures on medical botany to the students in the post-graduate medical course. Mr. Merrill is unusually energetic, and no doubt this work can be carried for a period of some months without seriously encroaching upon his regular work. However, it is manifestly impracticable for him to continue indefinitely devoting so much time to this work of instruction.

The nature and volume of the general routine work has continued to be about the same as for the preceding year, taxing our efforts to the utmost to accomplish the work with the present equipment and laboratory force. A considerable amount of the time of the mycologist was taken in reporting on diseased plants and parts of plants submitted by planters and others. Wherever possible, the fungus causing the trouble was determined and the remedy prescribed. In taxonomy the only group worked locally is the Basidiomycetes, all other fungi being submitted to specialists. The fungus *Metarrhizium anisoplioe* Sor., known as "green muscardine," which is parasitic on the coconut borer, has been isolated from specimens of the insect that had been killed by the fungus. Pure cultures of this parasite have been supplied to the government entomologist of German Samoa, to the mycologist of the Hawaiian Experiment Station, and to the Philippine Bureau of Agriculture for use in combating the pest.

The herbarium.—The burden of the herbarium work has fallen on the chief botanist since the assistant botanist is engaged

in field work most of his time. A total of 10,730 Philippine and foreign specimens for the six months ending December 31, 1913, and 18,738 for the calendar year 1914 have been poisoned, mounted, and distributed into the herbarium. Approximately 14,186 and 24,622 duplicates, respectively, for the two periods have been distributed by exchange to various scientific institutions and to individuals. Additional duplicate material is prepared and packed for shipment, awaiting more favorable conditions. The accumulated material was all distributed into sets ready for distribution at the end of July, but a number of sets cannot be shipped until the close of the present war. Mounted sheets totaling 431 and 678 specimens, respectively, have been loaned to specialists for study. During the calendar year over 600 duplicate unmounted specimens have been sent to specialists for identification. Such a large volume of work was accomplished by so few men only by the careful and faithful performance of many hours of overtime work. It is physically impossible to continue this indefinitely, and a decrease in the amount of work accomplished must be looked for during the coming year.

Philippine accessions.—The total number of Philippine plants added during the past year is 6,137. These have been received from many sources, by collection, by transmission from other departments of the Government for identification, and as gifts. The important collections of Philippine material are:

	Six months ended Dec. 31, 1913.	Calendar year 1914.
Collections of employees of the Bureau of Science	2,250	1,744
Collections of employees of the Bureau of Forestry	582	2,113
M. Vanoverberg for identification	325	47
C. F. Baker for identification and fungi in exchange	87	619
C. A. Wenzel for identification	521	690
F. C. Gates for identification	161	135
L. H. Taylor for identification	116	
H. Sandkuhl for identification	63	
A. D. E. Elmer by purchase and gift	1,148	
D. L. Topping as gift		43
R. S. Williams by exchange with the New York Botanical Garden		291

Identifications made during the calendar year approximate 9,000, which include the unnamed Philippine material incorporated in the herbarium during the year, a considerable number of plants from Borneo and Amboina, a number of specimens for the College of Agriculture, and nearly 1,000 specimens submitted by the Silliman Institute.

Foreign accessions.—Extra-Philippine material received by collection, in exchange, and for identification has been greater than in any foregoing year. A total of 5,130 and 12,601 specimens for the six months ending December 31, 1913, and for the calendar year 1914, respectively, have been received, poisoned, mounted, and distributed into the herbarium. Many of the specimens are of the greatest value for purposes of comparison, and a large number of cotypes are represented in some of the collections, notably in the material received from the Paris Museum, the largest and most valuable single collection received during the year.

Total accessions.—The specimens added to the herbarium from all sources to date increase the grand total of the herbarium to 149,141, of which about 87,500 are Philippine and 61,655 are extra-Philippine. It is estimated that nearly 3,000 additional specimens, Philippine and extra-Philippine, are on hand, but these have not been entered as the specimens are not yet arranged, numbered, or otherwise prepared for identification. Work on this material is being pushed as rapidly as possible.

In our coöperative work with the Bureau of Forestry the latter has arranged to install a small herbarium case at each forest station, and we have agreed not only to report the collections by number, giving the Filipino and scientific names and the family to which each species belongs as heretofore, but also to mount and return a duplicate of all botanical material sent in by the foresters, which will be sent to the forest station nearest to the place where the material was collected. Already 633 specimens have been mounted and returned. It is believed that this will add greatly to the value of the work done by the rangers and foresters, will stimulate interest on their part in the matter of collecting botanical specimens, and will tend to reduce the duplication of species as foresters and rangers change stations. As in the past, the original set of all material submitted by employees of the Bureau of Forestry is mounted and incorporated in the herbarium of the Bureau of Science.

The type collection.—Since it was improbable that fireproof quarters for our valuable herbarium could be procured soon, the entire type and cotype collection of 3,500 sheets was placed in special cases in the fireproof east wing of the Bureau of Science building, where it is arranged in families and genera. Each case is one half the size of a standard herbarium case. This size was selected so that the cases, with contents intact, could be removed from the building in case of emergency. Types and cotypes of cellular cryptogams have not been segregated.

The fact that types are stored in a part of the building far removed from the general herbarium has materially added to the difficulties in making current identifications, and much time is lost in going from the general collection to the type collection. This, however, cannot be safely remedied until proper fireproof quarters are supplied for the entire collection.

Publications.—A list of papers which have been published in Section C, Botany, of the Philippine Journal of Science is given elsewhere. A paper entitled "Philippine dipterocarp forests," by W. H. Brown and D. M. Mathews, prepared during the year, was published in, and fills the last two numbers of, Section A, Chemical and Geological Sciences and the Industries, of the Philippine Journal of Science. This paper is a very extensive and most important physiological and ecological study on the distribution, composition, effect of cutting and clearing, and management of the chief dipterocarp forests of the Philippines. Mr. Merrill has prepared an extensive paper entitled "A contribution to the bibliography of the botany of Borneo," containing over 500 titles, which has been submitted to Mr. J. C. Moulton, Sarawak, for publication in the Sarawak Museum Journal. Other papers by Mr. Merrill and Doctor Brown are in press, and still others are ready for the printer and in preparation.

Uncompleted work.—There are three especially extensive collections of extra-Philippine botanical material from Borneo, from China, and from Amboina, which have not been worked up, although considerable work has been done on the Borneo collection. Our most important project on extra-Philippine material is the one from Amboina, which was interrupted by the sad death of Doctor Robinson. His collections are now at the Bureau of Science. The collection as it stands is one of the most important that has been made in the Malay Archipelago—important, not so much from the fact that new species are to be expected, but because the bulk of the species represented will be of great value in interpreting the species of the older authors that by reference are based on the figures in Rumphius's Herbarium Amboinense and not on actual specimens. The material has been arranged in two series: First, those specimens that could be definitely referred to plants described or figured by Rumphius in his Herbarium Amboinense; and secondly, those that are apparently not described by Rumphius. The first series has been distributed into sets under the title "Plantae Rumphianae Amboinenses," the Rumphian name and reference being added to each label. It is planned, before distributing the ma-

terial, to add the modern botanical name in each case. The second series of specimens has been distributed into sets under the title "Reliquiae Robinsonianae."

Mr. Merrill's attempt to interpret the species described by the Spanish botanists Blanco and Llanos, of which no types are extant, is being continued. These species have been obscure to all botanists since they were described, because the authors preserved no botanical material. These species can be properly interpreted only by a careful study of the original descriptions in connection with all other data given by the authors—economic notes, native names, habitats, dates of flowering, etc.—comparing such data with our extensive collections of Philippine material, and searching for individual species in the exact localities mentioned by the authors.

Doctor Brown's investigations on the relation of environmental factors to the physical type of vegetation on Mount Maquiling are nearly completed. All of the chief types of Philippine vegetation are represented on this mountain. A thorough series of measurements, extending over two years, has been made on all types of vegetation and the occurrence of the different physical types thereby explained. His completed paper promises to be of great importance, for no similar work, at least on such an extensive scale, has ever been done in the tropics.

Field work.—Aside from the work on Mount Maquiling, exploration and collection trips were made to Samar, Laguna, Cavite, Rizal, Bulacan, Pangasinan, and Batangas Provinces. Mr. R. C. McGregor made an extensive and valuable collection in Biliran, an island previously quite unknown botanically. Mr. Merrill did field work in the vicinity of Baguio for about six weeks, and made a number of short trips in the vicinity of Manila. Rich collections from Leyte and Bontoc have been presented to the Bureau by Mr. C. A. Wenzel and by Father M. Vanoverbergh, respectively.

SECTION OF ICHTHYOLOGY OF THE BIOLOGICAL LABORATORY

Expert advice has been given regarding methods of fishing, the formulating of pearling and fishing laws, as well as information regarding the location of fishing banks and pearling beds, and instructions regarding the construction of fish ponds. The economic fisheries industries of the Islands, such as the production of window shells and other commercial shells, fish culture, the curing of trepang and other fishery products, and the establishment of sardine canneries, have been stimulated in many ways. The causes of poisoning from eating certain

fishes have been investigated. The fish expert has finished several inspection and collecting trips and has occasionally been detailed to solve definite problems. He has worked out a method of conserving the pearl fisheries and of increasing the revenue therefrom for the Department of Mindanao and Sulu.

Fish culture.—In 1913 a spawning pond for the mosquito fish, *Gambusia affinis,* was finished near the Bureau of Science. Notices have been published from time to time that mosquito fishes would be supplied free to any one who would apply. A large number have been distributed in the vicinity of Manila, and we have an ample stock ready for distribution.

The black bass, *Mycropterus salmoides,* brought originally from the United States in 1907, have increased in a most satisfactory manner, the two lakes and Trinidad River at Baguio being now well stocked. A shipment of black bass was established in Lake Lanao, Mindanao, on December 22, 1913. The spawning pond for black bass built near the Bureau of Science was inundated by the flood in September, but due to our prompt action in constructing a high fence around it only a few of the bass escaped. The pond is now stocked with between three and four dozen fine bass, which will probably spawn in a few weeks.

Investigation.—A very good collection of fishes from Mindoro has been identified, and several new species have been discovered. Several manuscripts relating to fish products in the tropics and describing new species of fishes have been prepared and published.

SECTION OF ORNITHOLOGY AND TAXIDERMY OF THE BIOLOGICAL LABORATORY

When the Bureau of Science was established little was known of Philippine birds. Considerable work has been carried on in order to determine the Philippine species. The classification of Philippine birds is a primary requisite to economic work on the subject. At the present time our effort is to furnish information with regard to the habits and distribution of beneficial and injurious birds and of game birds. A mounted collection of common forest birds has been prepared for the use of forestry students so that they may learn the birds of the forests and whether they are injurious or beneficial. This work has necessitated several details of the assistant collector to Los Baños. The chief and the assistant collector made a field trip to Biliran Island, Leyte Province, which occupied the period May 16 to July 8, 1914. A trip was made to Dagupan to collect water

birds. On several short trips which have been taken some work in collecting birds' stomach contents was done.

The study of the food habits of birds is a problem almost untouched in the Philippine Islands, and yet extensive work of this kind would lead to very important results. The determination of whether birds are injurious or beneficial is of the greatest importance to agriculture and forestry. Insectivorous birds hold in check insects which destroy leaf and twig. The results of the work which we have been able to do were issued on September 28, 1914, as a press bulletin, which was distributed for publication, entitled "Birds in their economic relation to man through agriculture and forestry." The work will be continued. This work is so important to the United States that it occupies much of the time of the Bureau of Biological Survey and a considerable portion of the time of the Department of Agriculture.

Several cases of mounted specimens have been added to the exhibit. A series of rats to be sent to the United States National Museum for identification has been prepared; deer heads, birds, and other animals have been mounted; collections of birds, sent to this Bureau for that purpose, have been identified.

One short paper has been published in the Philippine Journal of Science, and as heretofore, Mr. McGregor has continued to devote considerable time to the Bureau publications.

In so far as possible information has been furnished to the committee appointed on February 14, 1914, by His Excellency, the Governor-General, with regard to the breeding and other habits of Philippine birds and mammals in order that they might provide protection to animal life in these Islands. This information should be greatly extended.

SECTION OF ENTOMOLOGY OF THE BIOLOGICAL LABORATORY

Personnel.—On December 31, 1913, Mr. Willie Schultze, for ten years assistant entomologist of the Bureau of Science, severed his connection with the laboratory to accept a position in commercial life. He was a faithful employee, and through his zeal and energy our collections of Coleoptera and Lepidoptera were built up and arranged. He has completed a catalogue of Philippine Coleoptera which is ready for publication.

For five years Mr. C. S. Banks has been teaching entomology in the University of the Philippines. In July, 1914, the Honorable, the Secretary of the Interior decided to abolish the teaching function of the section of entomology, and on August 1, 1914, Mr. Banks was transferred to the University of the Philippines,

in which capacity he continues the supervision of the mosquito extermination project which was originally organized at the instigation of this Bureau. A Filipino employee, to whom can be entrusted the work of preparing and mounting insects for the cabinets, was added to the staff in 1913.

Routine work.—The work of this section has been to assist the Bureaus of Agriculture, Health, Forestry, and others in suggesting methods of exterminating such common pests as sugar cane insects, locusts, mosquitoes, flies, and forest insects; in classifying injurious and other insects; and in working out life histories and devising means of keeping insect pests in check. Considerable time has been consumed in furnishing information with reference to injurious insects and insecticides, and formulas for the preparation of the latter have been suggested when such were necessary. At present this work is largely suspended owing to lack of personnel.

Accessions.—During the last year and a half nearly 2,000 numbers have been added to the collection, which represent several times that number of insects. The extension of the collections is being continued through our trained assistants and by gifts.

Identification of material.—A number of entomologists have served in the identification of material and in the preparation of papers for publication, of which several have been published and a few are now on hand.

Silk.—The silk industry was introduced into the Philippine Islands by the Bureau of Science. Silkworms have now been grown for eight years and have never suffered from any disease. Our work in the culture of silk is being continued, and we are now raising our stock of about 10,000 silkworms each generation. There have been a large number of inquiries with reference to the industry and requests for silkworm eggs; and the desirability of extending the silk industry throughout the Philippine Islands becomes more apparent each year. There are very few people who have mulberry trees ready to feed the silkworms, and fewer still who have the requisite training to care for the worms, so that progress is slow. However, through the efforts of the Bureau of Science silk culture is steadily increasing in the Islands. It was introduced into one new province during August.

There is a large amount of work that ought to be done to ascertain the best races of silkworms that should be introduced and crossed with our own in order to retain our own worms in vigor and free from danger of disease. The need of a technically

trained individual to have actual charge of silk culture and its propaganda in the Philippines becomes more apparent as time goes on.

CHEMICAL LABORATORY

During the last school year Dr. Harry D. Gibbs, chief of the division of organic chemistry, and Mr. Albert H. Wells and Mr. F. Agcaoili, assistants in the division, were detailed for part of their time to the department of chemistry of the University of the Philippines, and Dr. A. P. West, an assistant in the division of general, inorganic, and physical chemistry, was detailed to give all of his time to the University. Mr. Albert E. W. King, an assistant in the latter division, has given a course in testing cement to students of the College of Engineering. The assistance has been given to the University at considerable sacrifice and interruption of the continuity of our work, and all with the exception of the course in cement testing had to be discontinued on account of resignations and the depletion of our staff.

Physical research.—Since my last report the work on the relation between the electrical and meteorological conditions of the atmosphere has been continued under the direction of Dr. J. R. Wright, the scope of the work being extended to include several additional correlated factors. Observations on the radium-emanation content of the atmosphere of Manila have been continued with the view of determining both the annual and diurnal variation with meteorological conditions. During April and May of the two preceding years an extensive series of observations has been taken on the top of Mount Pauai, Benguet subprovince, in order to determine the variation of the radium-emanation content with altitude. Simultaneously with the above investigation, observations have been taken on the amount of radium and thorium emanation in the atmosphere by the active-deposit method, the chief object of which is to determine the diurnal variation and its relation to the humidity, barometric pressure, and other meteorological factors. Work has also been started on the following problems: (1) Determination of the ionization of the atmosphere by Ebert's method, (2) determination of the rate of production of ions in a closed vessel due to the penetrating radiation from the radioactive substances in the atmosphere and the earth's crust, (3) determination of the diurnal variation of the potential gradient at the surface of the earth, and (4) the absolute value of the intensity of the rays from the sun.

All of the above problems are being studied in connection with the observations, taken daily at the Manila Observatory, of the intensity of the sunlight, humidity of the atmosphere, amount of rainfall, and the direction and velocity of air currents.

Apparatus.—Since my last published report we have received considerable new apparatus, the need of which has long been apparent. Among these are a 30,000-pound Olsen testing machine; a clay-pugging and brick-making machine from Chambers Bros. Co.; a Seger furnace; a rotary crusher; jaw crusher; roller cursher; and sieving machine for grinding and preparing ceramic, cement, road and concrete materials, and ores; and a 19-horsepower liquid-air machine purchased jointly by the Bureau of Science and the University of the Philippines, consisting of a 200-atmosphere, 3-step, vertical model compressor with a suction capacity of 54 cubic meters per minute, and an Olszevski apparatus for the liquefaction of air having a capacity of 3 liters per hour. These machines will greatly facilitate the work of this department, but it is desirable that a suitable permanent place be provided in which to protect them.

DIVISION OF GENERAL, INORGANIC, AND PHYSICAL CHEMISTRY

Personnel.—Mr. W. C. Reibling, chief of the division, went on leave in April and resigned September 15, 1914, to accept the position of superintendent of the American Tar Products Co., St. Louis, Mo., and Dr. A. P. West was transferred to the University on March 18, 1914. Mr. George W. Heise, physical chemist, arrived from the United States and began duty on July 24, 1913. Mr. Rutherford B. Martin resigned on November 19, 1913. Mr. Francisco D. Reyes and Mr. Emilio Natividad severed their connection with the Bureau on April 16 and October 31, 1914, respectively. Mr. Francisco Peña was appointed December 1, 1913. Mr. R. R. Williams was appointed on September 16, 1914, to fill the position of chief of the division. The research work of Mr. Williams has been largely in the field of biological chemistry. The losses suffered by resignation have not been made good, and the present staff is inadequate properly to carry on the work which should be done.

ROUTINE WORK

The routine work continues to be of the same general character as that described in the report for the fiscal year 1913. A classified summary of the routine work done by this division by periods since 1909 is included, as follows:

Nature of material.	1909-10	1910-11	1911-12	1912-13	July 1 to Dec. 31, 1913.	Calendar year 1914.
Rocks and minerals		25	46	12	3	
Soils, fertilizers, cements, and clays	3,342	3,738	8,636	9,617	5,137	6,884
Metals and alloys	24	46	36	45	14	51
Road materials, stone, gravel, sand, and concrete		400	248	130	136	132
Waters	82	164	146	197	126	208
Calorimeter determinations of fuels		29	9	31	7	7
Boiler tests of coal		10	2			
Standardizations of weights and measures (sets, except assorted)		1,066	990	1,127	[a] 1,321	1,300
Coal analyses		154	20	58	3	22
Miscellaneous [b]	248		248	91	60	88
Paints				46	33	41
Total	3,696	5,672	10,381	11,354	[c] 6,840	8,733

[a] Units.
[b] Work classified under Miscellaneous in 1910 is largely segregated in the following periods.
[c] Six months only.

This shows a reduction in the number of analyses of waters performed in the laboratory due to the inauguration of field examinations and in the number of cements on account of the limited funds available to the Government for public works.

The routine work of this one division was done at the request of individuals representing private or corporate interests and of officials in the following various departments of the Government: Bureaus of Agriculture, Constabulary, Customs, Education, Forestry, Health, Quarantine Service, Lands, Prisons, Public Works, Supply, and Science; the city of Manila; Provinces; municipalities; and the United States Army and Navy. It will be seen how generally the Bureau of Science is utilized. As indicated under the heading Committee on Standardization of Supplies, the conditions in the Philippines make it essential to do more or less research work in connection with almost every request. Results obtained prove conclusively the great need of standard requirements for all classes of material and the advisability of improving local products. For many of the materials such as crayon, blackboards, roofing, sensitized and cigarette paper, automobile tires, and tool steel sent to us for standardization no specifications were available. However, we devised tests, which in most instances were sufficiently effective to show the real or relative value and usefulness of the materials.

RESEARCH WORK

Specific investigations in various stages of completion are as follows:

Paints.—The systematic study of the efficiency and value of

different commercial pure and mixed paints to determine their actual value under local conditions is being carried on.

Field water survey.—A paper on water supplies in the Philippine Islands, by Alvin J. Cox, George W. Heise, and V. Q. Gana, has been completed and published. Field water survey work has been begun within the last three months and so far has been carried into Cebu and Iloilo Provinces. Its chief objects are to give immediate information to officials in charge of public works and sanitation and construction and to establish chemical standards for judging Philippine waters. It is possible to get the greatest accuracy only in the laboratory, but the rapidity and many other important factors more than compensate for the disadvantages of working in the field. Already this work has saved to the inhabitants of these Islands many times the cost of the undertaking.

Galvanized iron and tin plate.—Work was undertaken to show the chief causes of the diminished durability in a tropical climate of galvanized iron available on the market at present as compared with that of two or three decades ago. In connection with this work the excessive rusting of tin containers, which has entailed severe loss upon several local manufacturers, was studied. The problems involved were those of corrosion and protective coatings in general. Tin coating sufficient to give satisfactory results under normal condition of service is too thin and too poorly applied to prevent excessive corrosion under the slightly severe conditions of a tropical climate.

Iron smelting.—A study has been made of the modifications of Filipino smelting processes, which can be put into effect by small producers for an improvement in yield and quantity of iron and economy of production.

Lime burning.—Operations have been carried on to secure a small kiln that will be economical of fuel and serviceable to the small producer.

Cement.—Attempts have been made to produce a cheap pozzolana cement from volcanic tuff and lime which can be substituted for Portland cement in certain classes of construction. Papers on Burning tests of Philippine Portland cement raw materials, by Augustus P. West and Alvin J. Cox; The efficiency of Portland cement raw materials from Naga, Cebu, by W. C. Reibling and F. D. Reyes; and Natural cement versus brick; Iwahig Penal Colony raw materials, by W. C. Reibling, have been published.

Soils.—A paper on The soils of the Island of Luzon, by Alvin J. Cox and A. S. Argüelles, has been finished and published, and

Mr. Argüelles is now coöperating with Doctor Brown on a study of soils and soil moisture in relation to tropical vegetation.

Gas-producer operation.—A careful study of the chemical composition of producer gas has been made to develop the most economical generation.

Salt industry.—The study of the salt industry resources of the Philippine Islands has been continued, and means have been suggested for improving and increasing the output.

Brick making.—Clay and shales suitable for use in the manufacture of clay products, such as building and paving bricks, tiles, and common pottery, are abundant in the Philippine Islands. The Bureau of Science has demonstrated the suitability of these by manufacturing the products in the laboratory.

Leather industry.—Our chemists have shown that by simple, inexpensive modifications of their methods the local tanners can vastly improve their product in weight, finish, and durability, and particularly as to odor. This work has been carried on in Meycauayan. Already Filipino tanners have been very much interested, and the work should lead to important and practical results.

Many smaller problems have been touched upon, more or less superficially.

DIVISION OF ORGANIC CHEMISTRY

Personnel.—Dr. Harvey C. Brill and Mr. William B. O'Brien, new appointees, arrived from the United States and began service on July 24, 1913. Dr. Harry D. Gibbs, chief of the division and assistant to the Director, resigned on June 15, 1914, to accept a position with the United States Department of Agriculture, Washington, D. C., and Mr. O'Brien was transferred to the University of the Philippines on August 9, 1914. Dr. David S. Pratt, a member of the division, who was in charge of the division while Doctor Gibbs was on leave in the United States, from which he returned on September 9, 1913, was promoted on September 16, 1914, to the position of chief of the division to take effect upon his return to duty. Mr. Robert R. Williams was transferred to the division of general, inorganic, and physical chemistry as chief on September 16, 1914. No new appointments have been made, and the division is left in a depleted condition.

ROUTINE WORK

The routine work of this division consists of the inspection, analysis, and examination of foods, drinks, drugs, and other

organic substances. The routine work performed is shown in the following table:

Nature of sample.	Calendar year 1914.					Total for six months ended Dec. 31, 1913.
	Examined under Act No. 1655.	Adulterated or misbranded.	Government work (not included under Act No. 1655).	Private work.	Total.	
Dairy products	25	4	38	3	66	156
Meat products	19	8			19	23
Nonalcoholic drinks	9	1	32	5	46	45
Alcoholic drinks	3	1	10	3	16	33
Vegetables	23	7	8	4	35	14
Cereals			53	4	57	71
Fruit products	7	5		4	11	12
Essences and essential oils	16	14		17	33	18
Condiments	1	1	10		11	1
Oils			18	5	23	16
Drugs and medicines	[a]11	7	10	1	33	36
Clinical examinations			247	69	316	115
Opium and legal cases			44		44	12
Paper and textiles			108	1	109	96
Raw sugar			19	211	230	25
Sugar cane			21	57	78	12
Sugar food				2	2	
Copra			43	4	47	
Human milk			38	4	42	28
Commercial and miscellaneous			40	36	76	53
Total	114	48	739	430	1,294	566

[a] Examined under Act No. 2342, 11 samples; adulterated or misbranded, 4.

The clinical examinations and the analyses of sugar and sugar cane samples for the calendar year 1914 have increased over those of the fiscal year 1913, while the number of samples of foods examined is less. As most of the samples of food come from the Bureau of Customs, the decrease is readily explained by the shrinkage in imports on account of the European war and the fact that manufacturers have become better acquainted with the pure food laws and consequently violate their provisions less frequently.

The number of foods adulterated was 41.6 per cent in comparison with 19.5 per cent for 1912 and 27 per cent for 1913. The percentage found adulterated is higher than is the case in either of the other years cited. However, this is at least partly due to the fact that the officials of the Bureau of Customs exercise greater discretion in the choice of samples submitted.

The falling off of dairy products examined is due to the de-

crease in imports and to the fact that the special investigation of milks carried on by this laboratory, for the purpose of preparing standards for infant feeding, has been completed and the information made available.

The Food and Drugs Regulation Act No. 2342 has increased the correspondence and the number of consultations with importers and manufacturing druggists, and this work will be still greater when the imports of the Islands resume their normal condition. As the Bureau of Science member of the food and drug committee is the only one of that committee who has any technical knowledge of chemicals, the greater share of such work falls upon him. No statistical report of this work can be made, but it very often necessitates criticism of a large number of labels and the examination of a great deal of advertising matter to determine whether or not it is in violation of the law.

RESEARCH AND INVESTIGATION

With Dr. D. S. Pratt on leave, this division has but three men, and of necessity a large share of their time must be devoted to routine work. However, some research work has been done. Investigations under way, or practically completed, include: The examination of calumpang, the Catanduanes nut, and further work on the lumbang banucalag with drying tests of the oils; methods of rectifying ylang-ylang oil and some new discoveries regarding the same; the destructive distillation of Philippine woods with temperature control and a study of their products; a study of tiqui-tiqui and its relation to beriberi; a continuation of the effect of storage on various Philippine distilled wines and alcoholic distilled beverages; the extraction of the perfume of the flowers of the gardenia and of the camia; the curative chemical properties of a number of oils which have been confused with true chaulmoogrà oil, and an attempt to isolate a principle which will cure leprosy; the fermentation and manufacture of cacao from the dried bean; and the nipa palm as a commercial source of sugar.

A scientific investigation of several industries in India and Ceylon, which are the most advanced countries in the world from the standpoint of tropical agriculture, has been carried on in order to introduce into the Philippines, under the most favorable conditions, several industries, one of which is the papaya gum, or papain, industry. Papain possesses several properties superior to pepsin, which it is gradually replacing and which will increase the demand for the gum. Parke, Davis & Com-

pany state: "We employ approximately 2,500 to 3,000 pounds of papaya gum per year and obtain it at from $1.90 to $2.20 per pound. At present there is a great scarcity of good gum." Another firm writes: "We are willing to pay $3 per pound for really good juice and will take all that we can get at that price." There seems to be no reason why the Philippines should not supply the world's market with good, clean, active gum produced under careful supervision and by scientific methods.

The report of the Iloilo sugar laboratory is made separately on page 57.

DIVISION OF MINES

Personnel.—The staff of this division was seriously depleted during the year 1913 after it was definitely determined that a reduction in the staff for the ensuing year would be necessary. Where formerly we had five civil service men and one temporary geologist in this division, we now have only three authorized positions for geologists. At present the chief of the division and one other geologist are on duty. Mr. F. A. Dalburg went on leave in May, 1913, and subsequently resigned, effective November 14, 1913, and Mr. Paul R. Fanning went on leave on June 14, 1913, and did not return owing to the fact that his position was not provided for by the appropriation bill. Mr. Percy D. Kincaid, a temporary employee, resigned and left the service on April 30, 1913. Dr. Warren D. Smith, formerly chief of the division, resigned on June 16, 1914. Mr. Wallace E. Pratt was appointed chief of the division, effective June 16, 1914, and the work of the division, except the drafting and some of the assaying, was performed by him alone until Mr. Victor E. Lednicky, a new appointee, arrived from the United States and began service on October 22. Mr. A. E. W. King, of the division of general, inorganic, and physical chemistry, was assigned to assist with the assaying. By strenuous efforts Mr. Pratt and his assistants have completed a large amount of standard work, but it is essential that the staff of this division be maintained at not less than the full quota of three well-trained and well-paid scientific men if the work which the division does is to continue. Mr. I. J. Davis, a civil engineer in the employ of the Federal Government, was appointed an assistant of this division in March, 1914, without remuneration, and has devoted his spare time to work in the laboratory. Mr. R. A. Rowley, professor of geology in the University of the Philippines, has been continuing his petrographic study of Palawan rocks—begun when he was a partial employee of the Bureau of Science—and has

spent considerable time working in the division on this and other petrographic work.

ROUTINE WORK

During the last year and a half the regular assays for private parties and for prospectors in new districts as well as cyanidization of ores have been continued. One hundred sixty-seven assays, 34 bullion smeltings, and 209 placer gold weighings have been performed during the past year. The ore-dressing machinery already mentioned under the heading Chemical Laboratory is set up and available for use in the reduction of ores and rocks. Considerable time has been required in the preparation of an exhibit for the 1914 Philippine Exposition as well as in segregating a representative collection of mineral and other specimens suitable for the Panama-Pacific International Exposition in 1915.

Consultations with mining prospectors and operators, determinations of mineral specimens, and examinations of various classes of rocks have required a great deal of the time of the staff. The usual drafting necessary in the preparation of maps and drawings for publication in the Philippine Journal of Science has been carried on and in addition a number of placards and labels for the Bureau of Science exhibit at San Francisco have been made.

As heretofore there has been a demand for the services of the geologists in the development of local mineral resources on account of the inability to secure private engineers. It has been impossible to fill this demand entirely or to do as much field work as usual. The following work has been carried on: A general reconnaissance of northern Luzon and a geological reconnaissance of Caramoan Peninsula, Camarines Province; a private professional examination of the iron-ore deposit of the town of Mambulao, Camarines; a study of the landslide which threatens the safety of the Baguio Hospital; an inspection of the various mining properties near the town of Baguio; a private professional examination of certain limestone deposits in Laguna Province.

The relations of our scientists with the men interested in the mining industry have continued to be cordial. The reference list of Philippine mining corporations which was started some time ago has been extended and nearly completed. All of the data in our possession concerning the history, progress, and present status of every mining corporation, together with such information as we have concerning the geology of their mining

claims, have been brought together and are readily available. There has been an increasingly large number of inquiries from the general public with regard to the mining industry. The demand for advice on many matters of mining and mining laws and general mining subjects has also greatly increased, and there is greater knowledge and appreciation of the services which our specialists can render. We have received a greatly increased number of calls and inquiries from Filipinos, which indicates a growing interest on their part in the mineral resources of the country. Filipinos are especially interested in the iron-ore resources.

Mining legislation.—The past year has been marked by much interest in legislation concerning mining, and we have supplied a number of recommendations on various subjects relative to the mining industry; for example, that of requiring all stock-mining corporations to publish in their prospectuses a report by the division of mines of the Bureau of Science on the property which it proposes to exploit; on mine taxation; on special legislation to establish a school of mines; and other facts. The division of mines of this Bureau is in a position to know and to learn about the defects of, and needed changes in, the mining law more than any other department of the Government, and the opinion of our specialists should be considered in all matters pertaining to mining legislation. A study of the defects of our mining laws should be continued until some positive action along the lines recommended by this Bureau is taken.

INVESTIGATIONS AND PUBLICATIONS

The papers which the scientists of this division have contributed to the Philippine Journal of Science are included in the list given on page 39 and include titles which mark the completion of several large pieces of work upon which employees have been engaged for several years. The completion of the paper on Tayabas petroleum by Mr. Pratt and Doctor Smith should stimulate the development of that district. Work on the Angat, Bulacan, iron ores, including a microscopical study, and notes on the geology and underground water resources of Panay have been completed. There is considerable work in progress, including the examinations of cuttings from the deep wells drilled by the Bureau of Public Works. Preparations are now being made for a geologic exploration of the reported extensive iron-ore deposits in Surigao Province.

The Mineral Resources of the Philippine Islands for 1913 has been printed and is being distributed. It contains the following articles:

Review of the year, by Warren D. Smith.
Statistics of production.

THE METALS

The Paracale District, by F. T. Eddingfield.
The Aroroy District, Masbate, by Warren D. Smith.
Other mineral districts (including Baguio), by F. T. Eddingfield.
The Bulacan iron-ore resources, by Wallace E. Pratt.

THE NONMETALS

Coal mining in 1913, by Wallace E. Pratt.
Philippine production of nonmetals in 1913, by Wallace E. Pratt.

SPECIAL ARTICLES

Gold dredging in the Philippines, by William Kane.
Mine exploitation and the causes of some mine failures in the Philippines, by F. T. Eddingfield.
A preliminary check list of Philippine minerals, by Warren D. Smith, F. T. Eddingfield, and Paul R. Fanning.

In spite of the generally unsatisfactory economic conditions, Philippine mining has made much progress during the current year.

PHILIPPINE MUSEUM

The work of the division of ethnology has been reduced practically to that in connection with the Philippine museum as shown by the administrative order of the Secretary of the Interior of July 11, 1914 which states, "* * * The ethnological museum will be retained as an exhibit, but it will not be extended by further research * * *." Only those positions necessary for maintaining the museum were retained and appropriated for by the legislature. The resignations of Mr. Leslie F. Taylor and Mr. John M. Garvan were received, effective January 31, 1914, and September 21, 1914, respectively, and Mr. H. O. Beyer was transferred to the University of the Philippines on November 13, 1914,, effective after the collection of specimens for the Panama-Pacific International Exposition has been completed.

The splendid collections of Philippine hats, basketry, tools, weapons, agricultural implements, brass work, clothes and cloths, illustrating the life of the peoples of the Islands were kept open to the public from 7.30 a. m. to 5.00 p. m. on Monday to Friday and from 7.30 a. m. to 1.00 p m. on Saturday until November

when the best of the exhibit was sent to San Francisco as a part of the Bureau of Science display at the Panama-Pacific International Exposition. (See page 51.)

The study of the Ilocano people, begun four years ago, has been completed, and the report would have been in my hands before this except for the interruption of Mr. Christie's work to make a collection illustrating the life of the Visayan people with special reference to the Panama-Pacific International Exposition. Similar Tagalog, Pampanga, and Pangasinan collections have been made.

LIBRARY

Personnel.—Miss Emma E. Kinne, assistant librarian, went to the United States on leave on June 3, 1914, and resigned, effective September 14, 1914. There have been no other changes in the responsible personnel of the library. The organization and routine of the library has been continued as outlined in my Twelfth Annual Report. The apprentice system, inaugurated three years ago, has been very successful, not only in that the amount of money spent for carefully selected apprentices results in more intelligent service, but also a group of young people with an elementary knowledge of library science will become available for library work in other libraries in Manila and throughout the provinces and will interest themselves in the library extension and other public welfare work if we retain sufficient trained librarians to teach them. The record of the accomplishment of the library is as follows:

	July 1 to Dec. 31, 1913.			Calendar year 1914.		
	Volumes.	Parts.	Cards.	Volumes.	Parts.	Cards.
Cataloguing	2,984	1,182	2,139	4,032	1,256	3,299
Reclassification and subject work	359	89	671	16	17	28
Total	3,343	1,271	2,810	4,048	1,273	3,327
Printed cards			783			12,847
Total cards filed in official catalogue			3,593			16,174

The accessions from July 1 to December 31, 1913, and for the calendar year 1914 were 1,554 and 2,654 volumes, respectively, making a total number of 30,860 bound volumes in the library on December 31, 1914. A number of old and rare single publications and several sets of great value were received prior to December 31, 1913. Our orders for the calendar year 1914 have been restricted almost wholly to the continuation of serials

already in the library. Publications of the value of ₱8,785.53 have been delivered during the calendar year, leaving outstanding orders to the amount of ₱4,336.65.

The period during which the library was open was reduced, on account of the small library staff, from eighty hours per week to sixty-two hours by changing the closing hours from 9.00 p. m. to 6.00 p. m. on five days per week and the opening hour from 7.30 a. m. to 8.00 a. m. on six days. The use of books has decreased somewhat with the reduction in the library hours. From July 1 to December 31, 1913, and for the calendar year 1914, 12,021 and 22,830 publications, respectively, were issued—a monthly average of 1,936 and a daily average of 63.7.

Binding.—Seven hundred volumes were sent to the bindery and 941 volumes were returned from July 1 to December 31, 1913. Six hundred eight volumes remained at the bindery on December 31, 1913. Two hundred have been sent since that date. The entire 808 had been returned in July, and none have been sent since. Owing to the lack of funds, the binding is getting very much behind.

Classification and cataloguing.—All new material has been, and is being, classified and catalogued as received, and some progress has been made on the unclassified collection. The classification of college catalogues has been completed, and all new catalogues are added as received. Work on the trade catalogues has progressed, and many duplicates and obsolete publications have been discarded. This material is now in fairly workable shape. Work on the revision and classification of maps, charts, and blue prints has been begun, and the convenient arrangement of the maps in the specially provided cases will soon be completed. A large amount of miscellaneous work cannot be mentioned on account of lack of space.

Printed cards.—Comparison of the cost of printed and typewritten cards indicates that the cost of the latter is more than three times as much as that of the former. As soon as they can be handled, an effort will be made to secure printed cards, covering publications in the library, from as many available sources are possible.

Cuts.—Cuts from the Bureau of Science publications were numbered and arranged on shelves, and proofs of nearly 4,000 of them were pasted in an album. The proofs bear numbers corresponding with those on the cuts, and the second set is numbered in a reference set of the publications on the library shelves. An index to be made will give immediate access to any given cut or proof.

Reserve stock of the Philippine Journal of Science.—Collation of 75 reserve sets of the Philippine Journal of Science has been completed. Additions to this stock are now examined before reaching the library, so we can be reasonably certain that volumes of this publication sold or sent in exchange are complete.

Exchanges.—On account of the necessity for the strictest economy, little effort has been made to increase the exchange list of the Philippine Journal of Science. Valuable gifts and exchanges sent in return for the Annual Report of the Director of the Bureau and for Mineral Resources have added important publications to the library.

Library training.—During the college year 1913–14, two or three recitation periods were given to the five-year students in the College of Medicine and Surgery of the University of the Philippines to familiarize them with the Index Medicus. This work has been extended during 1914–15 to include from 8 to 10 recitation periods and, in addition, elementary work has been given in the use of the library shelf list, dictionary catalogue, and union catalogue, and in the use of reference books. Twenty-three students, each receiving one lesson per week, are enrolled in this course. The librarian of the Bureau of Science also coöperates in a course in library training offered by the College of Liberal Arts of the University of the Philippines.

ENGINEERING DIVISION

Since September 10, 1908, the engineering division has been entirely Filipinized. There have been no important changes in the direct supervision of the power plant during the period covered by this report. Mr. José Guerrero y Reyes remains as chief power engineer and Mr. Felix V. Valencia was appointed an assistant engineer on April 1, 1914, to relieve Mr. F. R. Ycasiano, who has drawn the plans and supervised the reconstruction of the Bureau of Science boiler units and is taking up the more important work of the mechanical and testing engineering which has been planned for several years.

Power plant.—The function of the central power plant for the Philippine General Hospital, the Bureau of Science, and the College of Medicine and Surgery, which is under the direction of this Bureau, was fully described on page 91 of my Twelfth Annual Report. The addition of a Dutch-oven furnace to the new boiler installed in 1913 has been a great success, and with this system we have obtained a saving of 2.82 per cent in the consumption of fuel. Under ordinary load it produces prac-

tically no smoke. There is no known method of eliminating smoke from a boiler when it is worked under an overload. The new boiler works so satisfactorily that there has been a restoration of funds with which to install two Dutch ovens in front of the two old boiler units. Plans have been drawn for the reconstruction of these ovens. The necessary arch bricks for making the Dutch ovens arrived from the United States, the ordinary fire bricks from Hongkong, and the work of raising the boilers 45.5 centimeters and reinstalling them has been completed during the year. Under ordinary load these two boilers produce practically no smoke. The elimination of smoke has always been a serious problem when bituminous coals are used, but we believe that the arrangement now in use in the Bureau of Science will be satisfactory and should be extended throughout the city as much as possible.

Producer-gas plant.—The producer-gas generator and the gas engine work satisfactorily. We have successfully used Batan coal in the 67-horsepower producer-gas unit for a year and a half, and the experiment has been vastly more successful than I anticipated. The consumption of coal in the producer-gas generator to generate gas used in the gas engine to operate a direct-coupled dynamo varies from 1.6 to 1.7 kilograms per kilowatt hour of electric current produced, whereas we used more than 4 kilograms of Japanese or Australian coal in our steam unit to generate a kilowatt hour of electric current. We have used other classes of noncoking coal satisfactorily in the producer-gas unit. Experiments were carried on to ascertain whether or not the producer-gas plant was capable of continuous operation. The manipulation of the generator has been so perfected that it has to be cleaned one third as often as formerly; in fact, at present it scarcely needs special cleaning at all. For eight months the producer-gas plant has been operated continuously, day and night, except when it was stopped for cleaning and repairs. A water spray in the vertical gas pipe from the gas generator and also another in the horizontal pipe connecting the vertical pipe with the scrubber cleans the gas more perfectly and prevents the incrustation of tar and dust that previously gave trouble. With proper care and adjustment a producer-gas generator and engine is a very reliable prime mover, and its use in this Bureau will result in great economy in the production of electric current. The advantages of the producer-gas engine over the steam engine will be still greater when we use the exhaust gases for heating water for the Philippine General

Hospital. It is very desirable that a second gas generator be installed in order to furnish a continuous supply of producer gas for the engine. During the night shift, when the producer-gas plant is running, a boiler is kept at high steam-pressure to operate one of the steam engines in case of accident in the gas engine in order to avoid any possible interruption of the light service in the hospital.

Engine room.—We have produced a slightly greater quantity of electric current than heretofore and have reduced the cost per kilowatt hour very materially when the producer-gas unit was operating. The amounts generated and delivered at the switchboard from July 1 to December 31, 1913, and for the calendar year 1914 are 125,881 and 272,742 kilowatt hours, respectively. For the fiscal year 1913 the average unit cost was ₱0.10129 per kilowatt hour. The average cost for the calendar year 1914 is ₱0.0895763. The lowest unit cost is ₱0.069091 per kilowatt hour for the month of July, when the producer-gas plant was operated continuously except for fifty-three hours and the price of coal was comparatively high. The fluctuating monthly cost per kilowatt hour was due to the variable price of coal and the length of time that the gas engine was run—that is, the more the gas engine was run, the less the cost per kilowatt hour. Of the total amount of current generated, 49.8 per cent was consumed in the Philippine General Hospital, 7.2 per cent in the College of Medicine and Surgery, and 43 per cent in the Bureau of Science. The total amount of steam generated in the boilers from July 1 to December 31, 1913, and for the calendar year 1914 is 5,262,185 and 10,518,377 kilograms, respectively.

Boiler room.—The unit cost of generating the last-named quantity of steam at 125 pounds per square inch gauge pressure is ₱0.002813 per kilogram. Of the total weight of steam generated 56.4 per cent was used in the Philippine General Hospital, 13.7 per cent in the Bureau of Science, and the remaining 29.9 per cent was consumed by the steam engines to generate electric power.

Mansfield gas-generating plant.—The total production of gas generated from the retorts from July 1 to December 31, 1913, and for the calendar year 1914, manufactured from kerosene and Cape lubricating oil, amounted to 298,681 cubic feet (8,458 cubic meters) and 645,124 cubic feet (18,270 cubic meters), respectively.

Shop.—The jobs completed in the carpenter and machine shop are as follows:

	July 1 to Dec. 31, 1913.	Calendar year 1914.
Bureau of Science	147	293
Bureau of Health	30	18
University of the Philippines	28	6
Other sources	13	11
Total	218	328

The jobs consist of repairing and nickel-plating surgical instruments, repairing photographic cameras, and constructing and erecting electric apparatus necessary for the various institutions, and do not include the necessary and emergency repairs to the power plant. The apparatus mentioned under Chemical Laboratory has been set up by the shop, and the apparatus damaged by fire in the distillation room has been repaired.

THE PHILIPPINE JOURNAL OF SCIENCE AND OTHER PUBLICATIONS

The Philippine Journal of Science is devoted to the scientific and commercial interests of the tropics. The periodical affords a place for the prompt publication of the results of original investigation by the employees of the Government of the Philippine Islands and of suitable investigations concerning any phase of life in the tropics by specialists in Europe and America. At the outset it was announced that the Journal would appear as often as material was available. During 1914 the Journal was issued in 4 sections, each of which contains 6 numbers; each section is separately paged and indexed. The designations of the sections remained the same as for 1913. In 1913 and 1914 the different sections contained the following:

	Section A.		Section B.		Section C.		Section D.	
	1913	1914	1913	1914	1913	1914	1913	1914
Pages	449	568	563	528	525	563	472	553
Plates	54	41	48	15	13	15	56	56
Text figures	38	38	1		7	14	33	45
Maps	4	3	2	1			1	
Charts				7				

The Philippine Journal of Science has published articles on chemistry, geology, mineralogy, bacteriology, protozoölogy, serum therapy, botany, marine zoölogy, anthropology, ornithology, entomology, ichthyology, mammalogy, ethnology, anatomy, surgery, and other allied subjects.

The numbers of the Philippine Journal of Science for the six months ending December 31, 1913, contain the following articles. Names of members of the Bureau of Science staff are marked by asterisks (*).

SECTION A. CHEMICAL AND GEOLOGICAL SCIENCES AND THE INDUSTRIES

* Pratt, David S. (Editorial) Copra spoilage on a large scale.

———. The absorption spectra of various phthalides and related compounds.

———, * Williams, R. R., * Thurlow, L. W., and * Gibbs, H. D. The nipa palm as a commercial source of sugar. A consideration of the principal difficulties encountered in collecting and preserving nipa palm sap.

* Pratt, Wallace E., and * Smith, Warren D. The geology and petroleum resources of the southern part of Bondoc Peninsula, Tayabas Province, P. I.

Saderra Maso, Miguel, and * Smith, Warren D. The relation of seismic disturbances in the Philippines to the geologic structure.

* Smith, Warren D. Contributions to the stratigraphy and fossil invertebrate fauna of the Philippine Islands.

* West, Augustus P. Analysis and composition of red lead.

SECTION B. TROPICAL MEDICINE

Asburn, P. M., Vedder, E. B., and Gentry, E. R. Concerning varioloid in Manila.

——— ——— ———. Some experiments on the inoculation of monkeys with smallpox.

* Barber, Marshall A. A bacteriological examination of certain artesian wells in Rizal, Cavite, and Bulacan Provinces, P. I.

———. An unusual disease prevailing in epidemic form at Buhi, Ambos Camarines, P. I.

———. The infection of Achlya with various microörganisms.

———. The variability of certain strains of dysentery bacilli as studied by the single-cell method.

Boynton, William Hutchins. Duration of the infectiveness of virulent rinderpest blood in the water leech, Hirudo boyntoni Wharton.

DuMez, A. G. The physical and chemical properties of the oleoresin of Aspidium with respect to the detection of adulterations.

Gibson, R. B. Proteoses and fever.

———. The influence of compensated salt mixtures on the development of polyneuritis gallinarum and beriberi.

———. The protective power of normal human milk against polyneuritis gallinarum (beriberi).

Heiser, Victor G., and Villafranca, Rafael. Albinism in the Philippine Islands.

Musgrave, W. E. Infant mortality in the Philippine Islands.
———, and Sison, A. G. Acute malignant glanders in man.
Reyes, C. M. Noma in the Philippine Islands with report of a case ending in recovery.
* Schöbl, Otto. Bacteriological observations made during the outbreak of plague in Manila in 1912.
* Walker, Ernest Linwood. The life history of œsophagostomum apiostomum: I. Development outside of the host.
———. Experimental balantidiasis.
———, with the coöperation of Sellards, Andrew Watson. Experimental entamœbic dysentery.

SECTION C. BOTANY

Ames, Oakes. Notes on Philippine orchids with descriptions of new species, VI.
* Brown, William H. The phenomenon of fatigue in the stigma of Martynia.
Copeland, E. B. Daily growth measurements of Lagerstroemia.
Gamble, J. Sykes. Some additional bamboos of the Philippine Islands.
* Graff, P. W. Additions to the basidiomycetous flora of the Philippines.
Kränzlin, F. Cyrtandraceae novae Philippinenses, II.
* Merrill, E. D. Plantae Wenzelianae.
———. Studies on Philippine Melastomataceae, I.
———. Studies on Philippine Melastomataceae, II.
Radlkofer, L. Enumeration sapindacearum philippinensium novarumque descriptio.
Rehm, H. Ascomycetes philippinenses, II.
———. Ascomycetes philippinenses, III.
Sydow, H. and P. Enumeration of Philippine fungi with notes and descriptions of new species. Part I: Micromycetes.
——— ———. Enumeration of Philippine fungi with notes and descriptions of new species, II.

SECTION D. GENERAL BIOLOGY, ETHNOLOGY, AND ANTHROPOLOGY

Bean, Robert Bennett. Filipino ears: IV. Ilongot and Mangyan.
———. Types among the inland tribes of Luzon and Mindanao.
Bezzi, M. Studies in Philippine Diptera. I.
Crawford, D. L. New genera and species of Psyllidæ from the Philippine Islands.
Gebien, Hans. Die Tenebrioniden der Philippinen.
Light, S. F. Notes on Philippine Alcyonaria. Part I: The Philippine species of the genus Capnella.
———. The morphology of Eudendrium griffini sp. nov.
Mocsáry, A. The Chrysididæ of the Philippine Islands.
Oshima, Masamitsu. Notes on the termites of Japan with description of one new species.
———. Two species of termites from Singapore.
Schenkling, Sigmund. Zwei neue philippinische Cleriden.
Wharton, Lawrence D. A description of some Philippine Thalassemæ with a revision of the genus.
———. Hirudo boyntoni, a new Philippine leech.

The titles of the articles in volume IX, 1914, with their respective authors are as follows:

SECTION A. CHEMICAL AND GEOLOGICAL SCIENCES AND THE INDUSTRIES

No. 1, February, 1914

* Cox, Alvin J., and Argüelles, A. S. The soils of the Island of Luzon.
Wright, J. R., and Smith, O. F. A quantitative determination of the radium emanation in the atmosphere and its variation with altitude and meteorological conditions.
West, August P., and * Cox, Alvin J. Burning tests of Philippine Portland cement raw materials.

No. 2, April, 1914

* Pratt, David S., and * Brill, Harvey, C. The absorption spectra of various phthalides and related compounds, II.
* Reibling, W. C., and * Reyes, F. D. The efficiency of Portland cement raw materials from Naga, Cebu.
* Pratt, Wallace E. Geology and field relations of Portland cement raw materials at Naga, Cebu.
* Reibling, W. C. Natural cement versus brick; Iwahig Penal Colony raw materials.
* Pratt, David S. The coconut and its products, with special reference to Ceylon.

No. 3, June, 1914

* Dalburg, F. A., and * Pratt, Wallace E. The iron ores of Bulacan Province, P. I.
Eddingfield, F. T. Microscopic study of the Bulacan iron ores.
Editorial: Notes on the geology of Port Arthur and vicinity.
Reviews.

No. 4, August, 1914

* Cox, Alvin J., * Heise, George W., and * Gana, V. Q. Water supplies in the Philippine Islands.

No. 5, October, 1914

* Brown, William H., and Mathews, Donald M. Philippine dipterocarp forests.

No. 6, December, 1914

* Brown, William H., and Mathews, Donald M. Philippine dipterocarp forests (concluded).

SECTION B. TROPICAL MEDICINE

No. 1, February, 1914

* Barber, M. A. Cockroaches and ants as carriers of the vibrios of Asiatic cholera.
Heiser, Victor G. Reappearance of plague in the Philippines after an absence of six years. Brief description of the outbreak, the methods used to combat it, and the probable factors in its introduction.

Boynton, William Hutchins. A preliminary report of experiments on the cultivation of the virus of rinderpest in vitro.

———. An atypical case of rinderpest in a carabao.

Ward, Archibald R., Wood, Frederick Willan, and Boynton, William Hutchins. Experiments upon the transmission of rinderpest.

* Willets, David G. Intestinal parasitism, particularly entamœbiasis, in patients of the Philippine General Hospital, Manila, P. I.

———. Preliminary report on the treatment of entamœbiasis with ipecac, emetine, and neosalvarsan at the Philippine General Hospital, Manila, P. I.

Gibson, R. B., and Concepcion, Isabelo. Nerve degeneration in fowls fed on unhusked rice (palay).

Ward, Archibald R., and Wood, Frederick Willan. Simultaneous method of inoculating cattle and carabao with serum from animals that have been recently immunized.

No. 2, April, 1914

A Joint Commission of Representatives from the College of Medicine and Surgery, University of the Philippines; Bureau of Science; and Bureau of Health. Sanitary survey of the San José Estate and adjacent properties on Mindoro Island, Philippine Islands, with special reference to the epidemiology of malaria.

No. 3, June, 1914

Calderon, Fernando. Some data concerning the medical geography of the Philippines.

* Schöbl, Otto. The etiology of trichomycosis palmellina in the Philippine Islands.

* Johnston, John A. A contribution to the bacteriology of leprosy. Preliminary note.

* Willets, David G. Intestinal helminthiasis in the Philippine Islands as indicated by examinations of prisoners upon admission to Bilibid Prison, Manila, P. I.

Musgrave, W. E., and Sison, A. G. Bacillary dysentery: The most prevalent form in Manila and its treatment.

* Willets, David G. Widal reactions among healthy adult Filipinos.

Boynton, William Hutchins. Experiments on the cultivation of rinderpest virus as described by Baldrey.

———. Kidney-worm infestation of swine in the Philippine Islands with special reference to the pathological changes.

Light, S. F. Another dangerous jellyfish in Philippine waters.

Gibson, R. B. Some simple laboratory apparatus.

Reviews.

No. 4, August, 1914

* Barber, Marshall A. The pipette method in the isolation of single microorganisms and in the inoculation of substances into living cells. With a technique for dissection, staining, and other processes carried out under the higher powers of the microscope.

* Crowell, B. C. Notes on the diagnosis of Asiatic cholera at autopsy.

Gutierrez, Perpetuo. Typhoid fever in the Philippines.

Reviews.

No. 5, October, 1914

* Walker, Ernest Linwood, and *Barber, Marshall A. The transmission of malaria in the Philippine Islands. I. Experiments with Anopheles (Myzomyia) febrifer sp. nov., Anopheles (Pseudomyzomyia) rossii, Anopheles (Myzorhynchus) barbirostris, Anopheles (Myzorhynchus) sinensis, and Anopheles (Nyssorhynchus) maculatus.
* Willets, David G. Malaria in the Philippine General Hospital, Manila, P. I., during the fiscal year 1913.
* Crowell, B. C. The chief intestinal lesions encountered in one thousand consecutive autopsies in Manila.
Reviews.

No. 6, December, 1914

* Ruediger, E. H. The germicidal power of glycerin on various microörganisms under various conditions.
* Schöbl, Otto. The vitality of the cholera vibro in Manila waters.
* Walker, Ernest Linwood. The morphology of the adults of the Filaria found in the Philippine Islands.
Acosta-Sison, Honoria. Pelvimetry and cephalometry among Filipinas.
Gibson, R. B. A note on the physiological action of the proteoses.
———, and Concepcion, Isabelo. The lymphagogic action of the Philippine mango, Mangifera indica Linnæus.
Concepcion, Isabelo. Observations on mango rash.
* Barber, M. A. Milk poisoning due to a type of Staphylococcus albus occurring in the udder of a healthy cow.
Reviews.

SECTION C. BOTANY

No. 1, February, 1914

Copeland, Edwin Bingham. New Papuan ferns.
Ames, Oakes. The orchids of Guam.
* Merrill, E. D. An enumeration of the plants of Guam.

No. 2, April, 1914

* Merrill, E. D. An enumeration of the plants of Guam (concluded).
Sydow, H. and P. Fungi from northern Palawan.

No. 3, June, 1914

* Merrill, E. D. Charles Budd Robinson, jr.
* Robinson, C. B. The geographic distribution of Philippine mosses.
Campbell, D. H. The genus Macroglossum Copeland.
Copeland, E. B. New Sumatran ferns.
* Graff, P. W. Philippine Basidiomycetes, II.
Hubbard, F. T. A new species of Rottboelia.
Ostenfeld, C. H. New or noteworthy aquatic plants.
* Merrill, E. D. New or noteworthy Philippine plants, X.

No. 4, August, 1914

* Merrill, E. D. New or noteworthy Philippine plants, X (concluded).
Bennett, A. The Potamogetons of the Philippine Islands.
Bresadola, G. and Sydow, H. Enumeration of Philippine Basidiomycetes.
* Merrill, E. D. Plantae Wenzelianae, II.

No. 5, October, 1914

Gates, Frank C. The pioneer vegetation of Taal Volcano.

Copeland, Edwin Bingham. Hawaiian ferns collected by M. l'Abbé U. Faurie.

* Merrill, E. D. Sertulum Bontocense: New or interesting plants collected in Bontoc Subprovince, Luzon, by Father Morice Vanoverbergh, II.

———. Notes on Philippine Euphorbiaceae, II.

No. 6, December, 1914

Gates, Frank C. Swamp vegetation in hot springs areas at Los Baños, Laguna, P. I.

* Merrill, E. D. New species of Eugenia.

———. New species of Schefflera.

———. Dilleniaceae novae.

———. Meliaceae novae.

SECTION D. GENERAL BIOLOGY, ETHNOLOGY, AND ANTHROPOLOGY

No. 1, February, 1914

* Seale, Alvin. Preservation of commercial fish and fishery products in the tropics.

Day, Artemas L. The osseous system of Ophiocephalus striatus Bloch.

Worcester, Dean C. Note on the occurrence of a flying crustacean in the Philippine Islands.

* Seale, Alvin. Fishes of Hongkong.

Kerremans, Ch. Buprestides recueillis aux îles Philippines par C. F. Baker, I.

* Schultze, W. Notes on the Malay pangolin, Manis javanica Desmarest.

No. 2, April, 1914

* Christie, Emerson B. Notes on irrigation and coöperative irrigation societies in Ilocos Norte.

———. Notes on the pottery industry in San Nicolas, Ilocos Norte.

Cain, Andrew W. History of the Spanish Normal School for men teachers in Manila 1865–1905.

Melichar, L. Neue Homopteren von den Philippinen.

Kieffer, J. J. Nouveaux Cynipides des Philippines.

Day, Artemas L. Two new cyprinoid fishes of the genus Barbus from Lake Manguao, Palawan, P. I.

No. 3, June, 1914

Light, S. F. Some Philippine Scyphomedusæ, including two new genera, five new species, and one new variety.

———. Notes on Philippine Alcyonaria. Part II: Lemnalioides kükenthali, a new genus and species of Alcyonaria from the Philippines and a discussion of the systematic position of the new genus.

Wileman, A. E. Notes on Japanese Lepidoptera and their larvæ: Part I.

Melichar, L. Neue Fulgoriden von den Philippinen: I. Theil.

Kieffer, J. J. Enumération des Serphides (Proctotrupides) des îles Philippines avec description de genres nouveaux et d'espèces nouvelles.

* Schultze, W. Notes on a nesting place of Crocodilus palustris Lesson.

No. 4, August, 1914

Cowles, R. P. Palaemons of the Philippine Islands.
* Banks, Charles S. A new Philippine malaria mosquito.
Crawford, J. C. New Philippine Hymenoptera.

No. 5, October, 1914

Kemp, Stanley. On a collection of stomatopod crustacea from the Philippine Islands.
Baker, C. F. Studies in Philippine Jassoidea. I. Some remarkable Tettigoniellidæ.
Bickhardt, H. Philippinische Histeriden: I.
Fleutiaux, Ed. Elateridæ des îles Philippines.
Raffray, A. Catalogue des psélaphides (Coleoptères) des îles Philippines.
Melichar, L. Neue Homopteren der Philippinen.

No. 6, December, 1914

Robertson, James A. The Igorots of Lepanto.
* McGregor, Richard C. Description of a new species of Prionochilus from the highlands of Luzon.
Grouvelle, A. Nitidulidæ des Philippines recoltés par C. F. Baker.

A bulky report of the Committee for the Investigation of the Cause of Excessive Infant Mortality in the Philippine Islands was edited and the proof was read. This publication was to appear as No. 6 in the Bureau of Science series of publications, but there has been some delay in the issue.

The Mineral Resources of the Philippine Islands for 1913 was issued during the year 1914, and copy for a new publications folder has been sent to press and should appear within a short time.

More or less work has been done on several manuscripts, most of which have not been sent to the printer. These are:

Schultze, W. A catalogue of the Coleoptera of the Philippine Islands.
Beyer, H. O. The Ifugao people.
Christie, E. B. The Ilocano people.
Garvan, J. M. The Manobos of Eastern Mindanao.
Livingston, C. E. The tarsila of Maguindanao.
Merrill, E. D. A critical consideration of the species described by Blanco and Llanos.
Graff, P. W. Bibliographic list of Philippine Basidiomycetes.

A 38-page folder, entitled "Industrial resources of the Philippine Islands," was issued in English and in Spanish early in the year, giving semipopular and bibliographical information on the following subjects which have been studied by members or are included in the work of the Bureau of Science:

Chemical Technology.—Sugar; The nipa palm; Palm brandy; Starch; Coconut and coconut products; Other vegetable oils; The perfume industry, essential oils, and terpenes; Papaya gum; Tanning materials; Philippine dyes; Paper pulp; Soils.

Limestone and silicate industries.—Portland cement; Sand-lime products; Lime; Fire clay; Vitrified and other clay products.

Nonmetallic mineral resources.—Abrasives; Alum; Artesian water; Asbestos; Clay products; Cement raw materials; Coal; Producer-gas plant; Corundum; Gems and precious stones; Guano and phosphates; Gypsum; Limestone; Manganese; Mica and talc; Mineral pitch; Mineral waters; Ocher; Petroleum and gas; Salt; Sand and gravel; Stone; Sulphur.

Metallic mineral resources.—Gold; Silver and lead; Copper; Iron and iron ore; Chromic iron; Antimony.

Bacteriology.

Botany.—Hats and hat making; Medicinal plants; Fungi; Coffee.

Entomology.—Cacao; Tobacco; Silk; Honey.

Fisheries.—Fish ponds; Food and game fishes; Pearl fisheries; Button shells; Window shell; Trepang (bêche de mer); Shark fin; Tortoise shell; Sponges; Edible seaweed and isinglass; Fish culture; Preserving fishery products.

Philippine birds.—Game birds.

Library.

Aquarium.

Manuscripts giving more extensive information on similar subjects were furnished for publication as folders for the Philippine Exhibit at the Panama-Pacific International Exposition. (See page 53.)

The Bureau of Science press bulletins have been useful in stimulating the interest of the public in the work which the Bureau of Science can do for it and in distributing useful information. The press bulletins issued are as follows:

Serial No.	Subject.	Date of issue.
17	Petroleum on Bondoc Peninsula, Tayabas Province, Philippines	July 9, 1913
18	Black bass fry for distribution	Sept. 1, 1913
19	The geology and petroleum resources of the southern part of Bondoc Peninsula, Tayabas Province, Philippines	Sept. 8, 1913
20	Amœbic dysentery	Sept. 25, 1913
21	Mosquito fish	Nov. 5, 1913
22	The Bureau of Science discovers gold in the drill cuttings from an artesian well at Casiguran, Sorsogon	Dec. 5, 1913
23	Coconut insects in the Philippine Islands	Jan. 3, 1914
24	Recent progress in the study of beriberi	Mar. 26, 1914
25	Statistics of production	Apr. 24, 1914
26	Circular sent to druggists with regard to extract of tiqui-tiqui	
27	Bacteria in Manila water supply	July 25, 1914
28	Rabies or hydrophobia. (English and Spanish)	July 29, 1914
29	On recent studies of beriberi	Aug. 3, 1914
30	The cigarette beetle. (English and Spanish)	Aug. 18, 1914
31	The molds of cigars and their prevention. (English and Spanish)	Sept. 19, 1914
32	Birds in their economic relation to man through agriculture and forestry. (English and Spanish)	Sept. 28, 1914
33	Report on the possible shortage of cyanide	Oct. 19, 1914
34	Report on fisheries of Mindanao and Sulu	Dec. 15, 1914

A series of colored post cards and a booklet of some of the most brillant and curious Philippine fishes are being issued for sale at the aquarium.

The necessary number of blanks and labels have been printed.

The mailing list for the Journal for the past three years has been as follows:

	1912	1913	1914
Paid subscriptions	341	447	347
Exchanges	400	427	465
Reviews	68	74	64
Free	46	49	49
Total mailing list	855	997	925

There has been a decrease in the number of paid subscriptions. This may be attributed to the European war, there having been practically no business transacted with any of the warring countries, except Great Britain, since last July and to a lack of funds for advertising. The mailing list has been thoroughly revised, which has helped to reduce the number of names remaining on the list.

It is difficult to keep the varied and widely scattered Journal accounts paid up. A follow-up system, as mechanical as it can be made under the circumstances, has been put into effect recently to secure more prompt settlements. The outstanding accounts at present amount to ₱1,399.65 as against ₱1,495.96 for the year 1913, which shows some improvement even in a short time. The cost of printing the Journal for the first eleven months of this year amounts to ₱20,785.33, which indicates a somewhat less annual cost than formerly.

CLERICAL DIVISION

Miss Celesta Cromer, stenographer to the Director, resigned effective August 29, 1913, and her place was taken by Miss L. Soriano, a Filipino junior stenographer. This step was taken in the interest of the Filipinization of the service and as an opportunity to train a Filipino stenographer in broader and more original lines of clerical work. The Filipino stenographer lacks the thorough knowledge of English and the many years of business experience of Miss Cromer, but by exercising personal supervision of some of the details she has performed the routine stenographic and clerical duties of the office as well as was expected and has improved remarkably during the past year.

An American stenographer, who is occasionally called upon to help out on extra and rush work, is available in the general office. Mr. Grady P. Oakly left the Bureau in October, and his position was dropped. Mr. A. E. Southard, chief clerk, was detailed as private secretary to the Honorable, the Secretary of the Interior, on August 16, 1914, for the remainder of the year. Two years ago there were five Americans in the clerical division as against three authorized places at the present time—namely, the chief clerk, a stenographer detailed to the accounting office and supervision of the files, and the cashier and disbursing and property officer—a reduction of 40 per cent. Our Filipino stenographers have done very good work, but the facts that English is not their native language and that they are inexperienced in general business and office work limit their ability to combine speed with accuracy, although they show decided improvement from year to year. For this reason it will be impossible further to reduce the American personnel of this division.

The files are still in an unfinished condition, although a large amount of work has been done upon them. Mr. Evans has been detailed to supervise the filing, and under his direction the files can be brought up to date within the coming year.

The work of the sample clerk increased so much that it was impossible for him to keep up with it unless he worked from twelve to fourteen hours a day. His work has been divided and the minor part given to an assistant.

I am convinced that the plan of dividing our allotment for clerical hire among fewer clerks, which enables us to pay sufficiently high rates of compensation to attract the more efficient men, is most economical.

A large amount of extra work has been required of the property section on account of the necessity of checking all the specimens that were sent to the Panama-Pacific International Exposition.

The care of the lawns, hedges, etc., formerly done by the city of Manila at our expense, has been taken over by the Bureau as a measure of economy. The telephone service is still the cause of some complaint. A new switchboard has been installed, but the operator reports that it is often out of order. The muchacho service has continued to be satisfactory since the adoption, about three years ago, of the present rules and regulations governing that matter.

PHOTOGRAPHY

The record of the photographic work is as follows:

Kind of work.	July 1 to Dec. 31, 1913.	Calendar year 1914.
Negatives taken	473	458
Lantern slides	974	875
Prints, 5 by 7 inches	7,503	10,718
Enlargements, 14 by 17 inches	116	262
Transparencies, 8 by 10 inches	86	53

AQUARIUM

The aquarium of the Bureau of Science is situated in Manila on Calle Gral. Luna (Palacio) within the bastion of the Real Gate of the old Walled City, and the grounds have been parked and are very attractive.

The building is a substantial one-story structure of reënforced concrete, and follows the outline of the old bastion, which is that of an irregular pentagon. It consists of a single corridor or tunnel, 57 meters (275 feet) long and 8 meters (25 feet) wide. There are 27 exhibition tanks, each of which is faced with plate glass 1 inch thick, set in solid iron frames 1 by 2 meters (3.25 by 6.5 feet), and lighted by skylights, one over each tank. The backs of the tanks slope, so there are no unlighted corners, and practically all the light in the corridor comes through the tanks, which allows a most satisfactory view of the fishes. Louvers placed above the tanks and in the opposite wall provide ventilation and render the corridor cool. Electric lights placed near the skylights provide light for evening displays. There are two large tanks about 12 meters (40 feet) in diameter outside of the corridor—one for crocodiles and the other for large fishes, sharks, or turtles, which may be seen from within the corridor and present a pleasing grotto effect.

The storage tanks are provided with a capacity of 95,000 liters (25,000 gallons) of water. The closed circulation system is used. The water is returned to the supply tank from the aquaria through sand filters by means of an electric pump, and the water is used over and over again. This is the same system as is used in the New York Aquarium. Each aquarium is equipped so it can be supplied with fresh water and air as well as salt water. A lead salt-water pipe system is used throughout to prevent corrosion.

The aquarium was opened in February during the 1914 Philippine Exposition. In the exhibition tanks we maintain a large

and complete display of curious and bright-colored fishes, sea anemones, crabs, sea urchins, starfishes, and other representatives of the wonderful and interesting forms of marine life found in the tropical waters of the Philippine Islands. The two large tanks outside of the corridor are stocked with crocodiles, turtles, and large fishes. A certain number of goldfishes and other fresh water fishes are on display. In the aquarium at present there are 756 specimens representing 154 species of fishes, 10 species of crabs, 3 species of suckers, 2 species of turtles, and a number of species of prawns and other shellfishes. The aquarium is one of the best of its kind in the world. Stone steps lead to the top of the old bastion wall, from which a fine view of the harbor, shipping, Luneta, and bay shore can be obtained. The aquarium is self-supporting. Since it was opened there have been 33,621 paid and 28,052 free admissions. The latter consist of those who attended during the opening days and when we had certain free days, and of students and teachers of schools who have been admitted by special arrangement.

BUREAU OF SCIENCE EXHIBIT AT THE 1914 PHILIPPINE EXPOSITION

The Second Philippine Exposition was held in Manila, February 7 to 15, 1914. It is very difficult properly to represent the various activities of the Bureau of Science at an exposition for the reason that much of the work is of such a nature that it does not lend itself to exposition purposes. However, a very interesting exhibit was displayed, and the Bureau received a beautiful silver tablet bearing the coat-of-arms of the Government of the Philippine Islands which reads as follows:

> Awarded by the Philippine Exposition Board to the Bureau of Science for its exhibit at the Philippine Exposition of 1914 of the industrial resources of the Philippines, including calcareous and siliceous, nipa and other chemical products, mining and minerals, botany, ethnology, fishery, silk and bird exhibits, and for educational models and apparatus.

A full account of the Bureau of Science exhibit at the 1914 Philippine Exposition was published in the Philippine Agricultural Review (1914), 7, No. 4, April, 156–66.

PANAMA-PACIFIC INTERNATIONAL EXPOSITION EXHIBIT

The Bureau of Science sent to San Francisco for the Panama-Pacific International Exposition to be held February to December, 1915, 72 large packing cases filled with exhibits for the 3,946 square feet (366.5 square meters) of floor space allotted to us in the Philippine building. The Bureau of Science display consists of nearly 4,000 items representing (1) applied chemistry in Philippine industry, including numerous samples of wood,

distillates and charcoals, tan barks, tanning cutch and tanned hides, paper made from local fibers, fruit products, essences, oils and beverages, information with regard to Philippine water supply from sanitary and commercial standpoints, Philippine coals, their analyses and results of physical and chemical tests, cement and concrete, limestone and lime from local resources, sand-lime bricks, tile, clay products and polished artificial marbles made from Philippine raw materials, various products from leaves—for example, roselle—and nipa palm and its products; (2) Philippine mineral resources and geology, including ores, coal, corals, fossils, and shells, models of Philippine processes and of gold production by years, relief maps, geologic maps, mineralogic maps, charts showing economic mineral products by years and distribution, and photographs; (3) Philippine ethnology, portraying the culture, social life, ceremonies, industries, and occupations of people in the Philippines, including everything from small ornaments, cloths, and garments to weaving looms, household utensiles, tools, agricultural implements, fishing boats, and even models of their houses, and miscellaneous industries, such as fish, silk, hemp, rope, basket, and hat making; (4) Philippine economic fishery products and resources, including food and game fishes, window and button shells, tortoise shell, and sponges; (5) Mounted Philippine botanical specimens; (6) an exhibit of the Philippine Journal of Science; and (7) scientific photographic collection and colored transparencies portraying the various types of Philippine tropical diseases and illustrating the Philippine Islands. The exhibit was shipped to San Francisco on November 7 and 15, 1914.

PANAMA-PACIFIC INTERNATIONAL EXPOSITION FILMS

The Bureau of Science has made over 10,000 feet of moving picture films of industrial, commercial, and scenic subjects in the Philippine Islands for the Philippine Board of the Panama-Pacific International Exposition to be held in San Francisco February to December, 1915. The subjects are:

Sugar: Cane planting, cultivating, cutting, transporting to mill, native evaporating plant, modern mill, sacking, and shipping.

Abacá (Manila hemp): Transplanting, cultivating, felling, stripping, drying, pressing and baling, transporting, classifying, and loading for transportation.

Coconuts and coconut products: A coconut grove, gathering, transporting in small boats and rafts, husking and opening coconuts, drying copra (coconut meat partly dried), sacking, shipping, Filipino method of making coconut oil, and modern oil mill.

Minor industries: Pillow lace making in Bilibid Prison, paper flower making in Concordia Convent, match factory, nipa alcohol distillery, etc.

Pagsanjan Falls.
The modern Fire Department of the city of Manila.
Views in Manila and vicinity: Central Private School for girls, Jesuit fathers with scholars, Tondo market, the estero traffic, shipping on Pasig River, Bridge of Spain, the Escolta, Plaza Moraga, Santa Cruz Bridge, Plaza Goiti.
Public school children: Including those in Cavite and Laguna Provinces and the city of Manila, and some of the industries taught in the schools.

MANUSCRIPTS FOR THE PHILIPPINE BOARD OF THE PANAMA-PACIFIC INTERNATIONAL EXPOSITION

Semipopular accounts of a great variety of industries, some of which can be developed as the result of investigations of the Bureau of Science, have been prepared for publication as folders of the Philippine exhibit at the Panama-Pacific International Exposition. The subjects treated are in many cases the same as those discussed in my Annual Report for 1913 and in our folder, Industrial resources of the Philippine Islands, published early in the year, in which a great many more subjects were less extensively treated. The subjects of manuscripts prepared for the exposition are as follows:

Vegetable and essential oils.
Medicinal plants.
The vegetation of the Philippines.
Paper materials.
Sugar and alcohol from palm saps.
Mangrove swamps.
Resin, turpentine, and wood distillates.
Papaya gum.
Gold.
Cement raw materials.
Iron-ore deposits.
Petroleum, natural gas, and asphalt.
Pearl fisheries; button and window shells.
Coal deposits.
Lime and lime products.
Copper and manganese.
Stone, sand, and gravel.
Clay and clay products.
Sulphur deposits.
Minor metallic resources.
Miscellaneous nonmetals.
Possibilities of a modern salt plant.
Leather industry.
Food and game fishes.
Game birds.
Tortoise shell, bêche de mer, shark fin, and sponges.

RECOMMENDATIONS

During the past calendar year we have had available for the work of the Bureau of Science ₱381,084.

In my annual report for 1913 I pointed out that the work of maintaining a constantly growing Bureau which is in effect a department of information has seriously handicapped us in carrying on new lines of investigation as well as completing those which have already been begun. We are in the greatest need of more scientific employees and equipment to handle the additional work which has devolved upon us. During each of the three years in which I have been in charge of the Bureau of Science there has been an increase in the amount of work and a decrease in the number of authorized civil service positions in the Bureau. It follows that the research of the Bureau most necessary for the industrial, economic, and sanitary development of the Philippine Islands must suffer unless its routine work is reduced or funds available are increased. In spite of the large amount of routine work, the researches of the Bureau have been extensive and have included such problems as the investigation of plague, cholera, bacillary dysentery, tuberculosis, leprosy, balantidiasis, malaria, beriberi, and other diseases of man; problems of immunity and tropical sanitation; the eradication of household and other insect pests; and the investigation of sugar, the nipa palm, palm brandy, starch, coconuts and coconut products, other vegetable oils, the perfume industry, essential oils, terpenes, papaya gum, tanning materials, Philippine dyes, paper pulp, soils, Portland cement, sand-lime products, lime, fire clay, vitrified and other clay products, abrasives, alum, artesian water, asbestos, clay products, cement raw materials, coal, producer-gas plant, corundum, gems and precious stones, guano and phosphates, gypsum, limestone, manganese, mica and talc, mineral pitch, mineral waters, ocher, petroleum and gas, salt, sand and gravel, stone, sulphur, gold, silver, lead, copper, iron and iron ore, chromic iron, antimony, hats and hat making, medicinal plants, fungi, coffee, cacao, tobacco, silk, honey, fish ponds, food and game fishes, pearl fisheries, button shells, window shell, trepang (bêche de mer), shark fin, tortoise shell, sponges, edible seaweed and isinglass, fish culture, preserving fishery products, game birds, etc. The Philippine Islands need this class of research, and the legislature should give this work its support in order to protect and build up the public health and in order that capitalists may be shown where to invest. Such a large volume of work as has been accomplished during the past year could not have been accomplished by so few men during official hours. Men will not remain indefinitely under these conditions. It is unfair to reduce the staff so much that it is necessary to put in much overtime to complete the

work. To attract and hold good men, opportunities for constructive work must be presented; no scientific man is willing indefinitely to devote the bulk of his time to purely routine work. The routine work in certain sections of the Bureau of Science is overwhelming our depleted force, rendering it difficult or practically impossible to attain constructive results. If the work is to progress at all, it is necessary that additional employees be added to the staff. The present appropriation to the Bureau of Science is the basis of retaining that which we have already accomplished rather than being sufficient as a basis of progressive work. In view of the decreased revenue of the Government, this is satisfactory as a temporary measure, but if the Bureau of Science is to lead the industrial development of the Philippine Islands as it should do in order to prevent extensive duplication and waste, a larger appropriation should be made.

Renewed recommendation.—Time has made no less desirable many of the things recommended in my annual reports for the last two years. A new wing is urgently needed to provide adequate quarters for the testing of cement, reënforced iron, steel, rope, wire, road materials, tiles, cement pipes, concrete, mortar, building blocks, bricks, stone, and cloth, and to supply other additional room. Attention has repeatedly been called to the desirability of protecting the exceedingly valuable herbarium of the Bureau of Science against possible destruction by fire. The main building of the Bureau of Science is far from fireproof, and fires are notoriously common in buildings in which chemical investigations are carried on. The number of fires that have occurred in the Bureau of Science is considerable, and one during the last year was serious. In its present location, the herbarium, in case of fire, would be a total loss, especially should the fire gain headway in the attic of the building. Ordinary libraries, scientific instruments, etc., can be replaced in case of destruction. Scientific collections, such as herbaria, if once destroyed can never be replaced. Other collections can be built up, but new collections can never have the same value, scientific or otherwise, as older ones, like that of the Bureau of Science herbarium which contains a high percentage of types and cotypes.

As already pointed out, funds for a soil survey, the investigation of the subject of animal diseases, of insects injurious to agricultural products, a water survey, the purchase of books necessary to complete sets now in the central scientific library, reissuing of exhausted editions of certain publications, and enlarging the scope of our present work on the fish and fisheries of the Philippine Islands are needed. As heretofore, I heartily

recommend that an appropriation for these purposes be made when funds are available.

Philippine flora.—Mr. Merrill has continued his work on geographic distribution and classification, taking up economic phases of the subject as occasion arises. Data and material have accumulated to such an extent that it is highly desirable that work be commenced on a comprehensive systematic enumeration of Philippine plants, or perhaps on the preparation of a comprehensive flora of the Philippines. Such a work would gather up all the data that are available on the distribution of the numerous species both in the Philippines and outside of the Archipelago. The value of such a work would be great, for it would not only record valid native names and most important uses and make available in compact form all the results of our twelve years work on the classification and taxonomy of 7,500 species of Philippine flowering plants and ferns, practically all of which are represented in the collections of the Bureau of Science, but also that of all other botanists who have worked on the flora of the region, information which is now found scattered through hundreds of separate articles in the botanical literature of America, Europe, Asia, and Australia. With the reduction in the Bureau staff, the increase in routine work, and the increase in duties of instruction at the University, it has been quite impossible to begin this work. Desirable as it is, nothing can be done on the subject until our botanical force is increased and Mr. Merrill is relieved of a part of his duties at the University. With a force of but two men, one of whom is in the field practically all of the time, it is a manifestly impossible task to keep up the routine work of the herbarium, prepare and edit the manuscripts of the section of botany of the Philippine Journal of Science, teach from nine to eighteen hours per week at the University, and do anything else. Under present conditions economic problems must be slighted, and some very important phases of economic work ignored. Due to the familiarity of Mr. E. D. Merrill, the chief botanist, with the Philippine flora, the work of preparation of the manuscript will be comparatively easy, and no other botanist is in a position to undertake such a task without many years of previous experience on the Philippine and Malayan floras; therefore I recommend that the personnel be increased to permit Mr. Merrill to prepare this manuscript and that ₱2,000 be made available during the calendar year 1916 for printing the same.

Robinson memorial.—You are already familiar with the work of Dr. C. B. Robinson and the circumstances concerning his

death. Up to the time of his death he had submitted 125 pages of a single-space typewritten progress report. This information is of the greatest scientific value, and this, together with work now being and yet to be done upon his collection brought from Buitenzorg by the chief botanist, should be published as a memorial to him. The interest in this publication will not be for the Philippines alone, and I have no doubt that the publication will sell extensively and that the money expended in printing it will be recovered through sale in a short time. Therefore I have the honor to recommend that ₱2,000 be appropriated for the purpose of publishing this work as a memorial volume to Doctor Robinson, whose life was sacrificed in collecting the material.

Iloilo sugar laboratory.—My last annual report gives a clear idea of the routine work of the laboratory and of the large amount of instruction with regard to planting and harvesting of cane, as well as the perfect recovery of the sugar which has been given. The records of the past year and a half show the eagerness with which both producers and dealers avail themselves of umpire polariscopic analyses in case of dispute and as a basis for valuation. Each year impresses us more thoroughly with the thousands of pesos which could be saved annually to the sugar growers if they had the scientific information necessary with regard to planting, harvesting, and recovering the sugar most efficiently and economically.

Last year I pointed out the need for a model central sugar mill at Iloilo. There are more and more central mills being erected throughout the country, but the deplorable lack of knowledge at some of the haciendas of the chemical processes involved in boiling sugar makes it desirable that men be trained to operate them. If funds are available, it would be an excellent investment for the Government to build and operate a model central mill and to use it in showing the people how the work should be carried on. The work of the sugar laboratory in Iloilo should be extended, and we should have enough trained men to send throughout the provinces to give instruction relative to the best chemical processes of handling cane juice.

There is a large amount of other important sugar work which should be inaugurated. There is no definite information as to what variety of cane is most desirable to plant. One variety is noted for its sweetness, another for the size of the stalk, and so on. The results obtained from different varieties in their home countries are often very different from those in other lands. It frequently happens that a given variety does well only on one kind of soil and in a given climate. The methods of planting,

fertilizing, irrigating, and cultivating need further study. The various problems in cane culture can be solved only by trial with careful chemical analysis of the soil and chemical analysis of the cane to determine the purity, fiber, and tonnage.

Restriction of useless routine work.—I called attention to the desirability of eliminating useless routine work on page 14 of my annual report for the year ending June 30, 1913, and also in response to a question of the committee appointed on July 10, 1913, by his Excellency, the Governor-General, "What provisions of law, regulations, or requirements of other bureaus cause you unnecessary expense?"

The following will illustrate what might be done in this line. The amœbæ which multiply in surface water are incapable of living as parasites in the intestines of man, and consequently are not concerned in the production of dysentery. It follows that the mere presence or absence of amœbæ has little sanitary significance, and the examination should be omitted where practicable. The purity of a paint does not fix its value as a protective coating, the percentage of chlorine does not establish the potability of water, and the bacteria count of water several hours in transit to the laboratory, unless packed on ice, has no value. Many requests for routine work are founded on a false impression of the value of the specified test. We are expected from the examination of individual samples and from the results obtained to draw conclusions which would be justified only after extended investigation and without which the analyses have no significance. On the other hand, requests for elaborate investigations are sometimes received when simple tests would suffice if the problems were made clear. Frequently the problem is of momentary interest and relatively little value and requires time and energy which should be available for more important results. My endeavors to discourage requests for analyses and examinations of doubtful value have not always been successful. With our reduced staff, unimportant routine work should not be done.

Tables showing the routine work performed and supplies manufactured and disposed of during the half year from July 1 to December 31, 1913, and during the calendar year 1914, by the Bureau of Science, and a financial statement showing the appropriation and how it was expended are attached hereto.

ALVIN J. COX,
Director, Bureau of Science.

To the Honorable,
The SECRETARY OF THE INTERIOR.

TABLE I.—*Comparative table of routine work performed and supplies manufactured and disposed of during the six months ended December 31, 1913, and during the calendar year 1914, as compared with the fiscal year 1913 (July 1, 1912, to June 30, 1913), by number or quantity and by value, arranged by subdivisions of the Bureau of Science.*

Subdivision of the Bureau of Science.	Samples or units.			Free.			Cash.			Total.		
	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.
General, inorganic, and physical chemistry.				*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*
Metals and alloys	45	14	51	201.50	41.00	98.00	273.10	58.51	436.50	474.60	99.51	534.50
Rocks, minerals, natural pigments, and similar substances	15	3		122.50	24.00		20.00			142.50	24.00	
Clays, shales, limestones, limes, wall plasters, cement, and slags	55	31	11	354.00	199.60	118.00	265.50	60.00	27.00	619.50	259.60	145.00
Fertilizers	10	9	14		30.00	27.00	108.00	59.00	132.00	108.00	89.00	159.00
Soils and similar substances	14	7	42	219.00	106.00	305.00	35.00	45.00	693.00	254.00	151.00	998.00
Coal analyses	58	3	22	615.00		45.00	173.00	29.00	276.00	788.00	29.00	321.00
Calorimetric tests of fuels	42	7	7	480.00	40.00	20.00	140.00	106.00	120.00	620.00	146.00	140.00
Waters	187	126	208	4,785.00	3,667.50	3,795.00	640.00	331.00	365.00	5,425.00	3,998.50	4,160.00
Crude chemical and miscellaneous analyses	35	15	88	120.25	63.00	244.50	306.40	137.00	289.50	426.65	200.00	534.00
Standard solutions	10	28	30	60.00	136.00	167.00	10.00	382.50	29.00	70.00	518.50	196.00
Physical test of wire, twin, fiber, textile, paper, and similar articles	48	16	31	33.00	58.00		157.00	8.00	90.50	190.00	66.00	90.50
Cements	9,535	5,093	6,817				9,129.05	6,356.85	7,641.20	9,129.05	6,356.85	7,641.20

TABLE I.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Subdivision of the Bureau of Science.	Samples or units.			Free.			Cash.			Total.		
	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.
General, inorganic, and physical chemistry—Continued.				*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc.	54	136	86	3.00	162.50		268.00	207.00	330.00	271.00	369.50	330.00
Standardization of road materials	62	1	15	99.50			415.50	15.00	170.15	515.00	15.00	170.15
Standardization of units of measures:												
Length	96	349	171			0.10	67.20	245.00	88.50	67.20	245.00	88.60
Capacities	154	31	312	15.00			4.00	18.00	99.40	19.00	18.00	99.40
Weights	667	890	776	66.00			3.50	89.00	79.95	69.50	89.00	79.95
Miscellaneous	210	51	41	143.43	1.90		10.80	31.50	54.00	154.23	33.40	54.00
Total	11,297	6,810	8,722	7,317.18	4,529.50	4,819.60	12,026.05	8,178.36	10,921.70	19,343.23	12,707.86	15,741.30
Organic chemistry.												
Urines, clinical and toxicological analyses	2,666	82	223	479.00	202.00	600.00	1,513.00	156.00	469.00	1,992.00	358.00	1,069.00
Essential oils and essences	37	17	11	15.00	7.50	15.00	273.00	120.00	89.50	288.00	127.50	104.50
Petroleum and products, copra, and similar materials	71	10	65	307.50	68.00	317.50	177.50	90.00	89.50	485.00	158.00	407.00
Paints, varnishes, and linseed oils	46	33	41	43.00		48.50	327.50	172.50	319.00	370.50	172.50	367.50
Gums, resins, and similar materials	3	8		10.00			10.00	29.00		20.00	29.00	

Paper and similar materials	107	94	104	1,223.00	940.00	1,040.00				1,223.00	940.00	1,040.00
Gastric juice, clinical examinations	12	19	52	250.00	270.00	540.00	75.00	15.00	15.00	325.00	285.00	555.00
Foods, alcohols, and beverages	1,035	440	582	11,605.00	3,391.00	2,994.00	914.50	3,160.37	884.00	12,519.50	6,551.37	3,878.00
Food preservatives and coloring matters	19	7	5	115.00	90.00	45.00	14.00	6.00	4.00	129.00	96.00	49.00
Medicines and similar articles	232	43	38	1,271.00	370.00	255.00	93.00	25.00	140.00	1,364.00	395.00	395.00
Miscellaneous chemical analyses and examinations	77	21	68	452.00	95.00	266.00	96.00	95.00	100.00	548.00	190.00	366.00
Total	4,305	774	1,192	15,770.50	5,433.50	6,121.00	3,493.50	3,868.87	2,110.00	19,264.00	9,302.37	8,231.00
Mines.												
Assays	288	219	411	196.00		19.00	598.67	360.50	653.45	794.67	360.50	672.45
Biological laboratory.												
Fæces	34,530	24,502	126,226	273,187.00	322,839.00	2,861,707.00	1,147.00	341.00	1,371.00	274,334.00	323,180.00	2,863,078.00
Sputum	5,770	1,919	2,095	17,177.00	5,691.00	6,177.00	111.00	68.00	108.00	17,288.00	5,759.00	6,285.00
Blood	25,539	8,780	6,398	77,970.00	28,376.00	22,206.00	2,816.00	903.00	422.00	80,786.00	29,279.00	22,628.00
Blood culture		185	392		895.00	1,940.00		38.00	20.00		933.00	1,960.00
Widal test		316	599		948.00	1,770.00			33.00		948.00	1,803.00
Wassermann test		798	1,259		6,950.00	9,550.00		1,030.00	3,040.00		7,980.00	12,590.00
Leprosy		243	1,132		729.00	3,387.00			9.00		729.00	3,396.00
Urines	6,974	5,309	4,275	26,991.00	15,477.00	12,585.00		469.00	242.00	26,991.00	15,946.00	12,827.00
Gonococci	20,522	8,541	16,379	54,312.00	25,611.00	49,065.00	18.00	12.00	72.00	54,330.00	25,623.00	49,137.00
Waters	1,077	1,211	2,243	41,815.00	48,210.00	83,810.00	750.00	290.00	320.00	42,565.00	48,500.00	84,130.00
Necropsies	87	142	401	2,519.00	3,550.00	10,025.00				2,519.00	3,550.00	10,025.00
Histological examinations		322	256		3,190.00	2,480.00		30.00	80.00		3,220.00	2,560.00
Rabies		14	36									
Plague		13	65		39.00	195.00					39.00	195.00
Rats for plague		27,564	113,337		82,692.00	340,011.00					82,692.00	340,011.00
Miscellaneous biological examinations	57,972	796	1,755	172,392.00	2,512.00	8,601.00	85.00	26.00	548.00	172,477.00	2,538.00	9,149.00
Total	152,471	80,655	276,848	666,363.00	547,709.00	3,413,509.00	4,927.00	3,207.00	6,265.00	671,290.00	550,916.00	3,419,774.00

TABLE I.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Subdivision of the Bureau of Science.	Samples or units.			Free.			Cash.			Total.		
	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.
Serum section of the biological laboratory.				*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*
Vaccine virus (doses)	2, 419, 723	1, 337, 669	2, 636, 335				28, 876. 55	13, 676. 54	29, 383. 05	28, 876. 55	13, 676. 54	29, 383. 05
Antirinderpest serum (cubic centimeters)	553, 666. 33	127, 499. 97	134, 333. 33				757. 15	218. 58	230. 29	757. 15	218. 58	230. 29
Mallein (doses)	280	711	815				345. 70	513. 00	545. 50	245. 70	513. 00	545. 50
Miscellaneous sera and preparations (cubic centimeters)	2, 833, 268	1, 737, 769	6, 524, 090				5, 267. 97	6, 287. 30	15, 009. 82	5, 267. 97	6, 287. 30	15, 009. 82
Total	5, 806, 937. 33	3, 203, 648. 97	9, 295, 573. 33				35, 147. 37	20, 695. 42	45, 168. 66	35, 147. 37	20, 695. 42	45, 168. 66
Miscellaneous.												
Photographs	14, 491	8, 873	16, 161	906. 92	76. 30	593. 00	7, 100. 26	4, 559. 80	4, 956. 54	8, 007. 18	4, 636. 10	5, 549. 54
Natural history specimens	84	1	8				127. 60	2. 00	81. 24	127. 60	2. 00	81. 24
Shop work	269	218	208	2, 456. 07	1, 050. 13	1, 212. 16	344. 20	238. 50	1, 154. 23	2, 800. 27	1, 288. 63	2, 366. 39
Miscellaneous work	26	28	52				622. 56	5, 029. 60	8, 081. 52	622. 56	5, 029. 60	8, 081. 52
Sale of publications							6, 364. 71	1, 881. 14	3, 433. 16	6, 364. 71	1, 881. 14	3, 433. 16
Refunded work not done etc. (deducted)							(137. 00)	(438. 81)	(82. 75)	(137. 00)	(438. 81)	(32. 75)
Power, gas, etc							34, 265. 70	16, 907. 03	31, 995. 70	34, 365. 70	16, 907. 03	31, 995. 70
Total	14, 880	9, 120	16, 429	3, 362. 99	1, 126. 43	1, 805. 16	48, 688. 03	28, 179. 26	49, 619. 64	52, 051. 02	29, 305. 69	51, 425. 80
Grand total	5, 990, 178. 33	3, 301, 226. 97	9, 599, 175. 33	693, 009. 67	558, 798. 43	3, 426, 273. 76	104, 880. 62	64, 489. 41	114, 738. 45	797, 890. 29	623, 287. 84	3, 541, 012. 21

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of during the six months ending December 31, 1913, and during the calendar year 1914, as compared with the fiscal year 1913 (July 1, 1912, to June 30, 1913) by number or quantity and by value, arranged with reference to Government and other patronage.*

Patron.	Samples or units.			Free.			Cash.			Total.		
	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.
Bureau of Agriculture.				*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*
Fertilizers		1	2		15.00	27.00					15.00	27.00
Soils and similar substances			11			275.00						275.00
Crude chemical and miscellaneous analyses		1			7.00						7.00	
Petroleum and products, copra, and similar materials			34			165.50						165.50
Foods, alcohols and beverages		22	59		248.00	298.00					248.00	298.00
Miscellaneous chemical analyses and examinations			3			30.00						30.00
Miscellaneous biological works and examinations	11			33.00						33.00		
Antirinderpest serum	553,666.33	127,499.97	134,333.33				757.15	218.58	230.29	757.15	218.58	230.29
Mallein	37	200	300				3.70	20.00	30.00	3.70	20.00	30.00
Miscellaneous sera and preparations		1,000						1.00			1.00	
Photographic work	278	25	17				85.60	19.40	3.40	85.60	19.40	3.40
Total	553,992.33	128,748.97	134,759.33	33.00	270.00	795.50	846.45	258.98	263.69	879.45	528.98	1,059.19

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Patron.	Samples or units.			Free.			Cash.			Total.		
	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.
Bureau of Coast and Geodetic Survey.												
Waters:				*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*
Chemical		1			15.00						15.00	
Biological		1			40.00						40.00	
Total		2			55.00						55.00	
Committee on Infant Mortality.												
Foods, alcohols and beverages		70						2,086.00			2,086.00	
Photographic work		23						64.00			64.00	
Total		93						2,150.00			2,150.00	
Consulting Architect.												
Photographic work	24						17.70			17.70		
Bureau of Customs.												
Metals and alloys	7	4	1	49.00	21.00	8.00				49.00	21.00	8.00
Fertilizers		1			15.00						15.00	
Soils and similar substances	3			9.00						9.00		
Waters, chemical			1			5.00						5.00
Waters, biological			42			1,860.00						1,860.00
Crude chemical and miscellaneous analyses		2	5		11.00	22.50					11.00	22.50
Standard solutions		3						15.00			15.00	

Standardization of units of measures:												
Weights	7						3.50			3.50		
Miscellaneous	8						0.80			0.80		
Petroleum and products, copra, and similar materials	2			20.00						20.00		
Paints, varnishes, and linseed oils	6		1	3.00		3.50	16.00			19.00		3.50
Gums, resins, and similar materials	1			10.00						10.00		
Paper and similar materials	1	5	1	2.00	50.00	10.00				2.00	50.00	10.00
Foods, alcohols and beverages	7	1	7	31.00	15.00	92.00				31.00	15.00	92.00
Medicines and similar articles	42	9	1	206.00	85.00	10.00				206.00	85.00	10.00
Miscellaneous chemical analyses and examinations		1			5.00						5.00	
Photographic work	16						35.50			35.50		
Total	100	26	59	330.00	202.00	2,011.00	55.80	15.00		385.80	217.00	2,011.00
Bureau of Education.												
Physical tests of wire, twine, fiber, textile, paper, and similar articles	3	2					12.00	8.00		12.00	8.00	
Standardization of road materials	1						15.00			15.00		
Paper and similar materials	6			18.00						18.00		
Photographic work	2,108	1,302	1,799				584.40	259.90	347.30	584.40	259.90	347.30
Shop work	1						2.15			2.15		
Miscellaneous work	6			30.00						30.00		
Total	2,125	1,304	1,799	48.00			613.55	267.90	347.30	661.55	267.90	347.30
Electrolysis Committee.												
Metals and alloys	5						63.60			63.60		
Executive Bureau.												
Photographic work	1,338	24	135				502.90	40.80	62.17	502.90	40.80	62.17

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Patron.	Samples or units.			Free.			Cash.			Total.		
	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.
Bureau of Forestry.				*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*
Coal analyses	1			15.00						15.00		
Calorimetric test of fuels	1			20.00						20.00		
Petroleum and products, copra, and similar materials			2			30.00						30.00
Miscellaneous chemical analyses and examinations		1						6.00			6.00	
Photographic work	263	362	882				52.20	300.20	227.17	52.20	300.20	227.17
Total	265	363	884	35.00		30.00	52.20	306.20	227.17	87.20	306.20	257.17
Bureau of Health.												
Metals and alloys			1			3.00						3.00
Clays, shales, limestones, limes, wall plasters, cements, and slags			1			3.00						3.00
Waters:												
Chemical	54	30	36	860.00	850.00	725.00				860.00	850.00	725.00
Biological	860	1,105	1,042	34,435.00	44,250.00	41,520.00				34,435.00	44,250.00	41,520.00
Crude chemical and miscellaneous analyses			3			11.00						11.00
Standard solutions		7						347.00			347.00	
Urines, clinical and toxicological analyses	7,563	60	146	21,367.00	202.00	600.00	1,383.00			22,750.00	202.00	600.00
Essential oils and essences			1			15.00						15.00

Petroleum and products, copra, and similar materials	1			5.00						5.00		
Paints, varnishes, and linseed oils	1		2	25.00		30.00				25.00		30.00
Gastric juice, clinical examinations	12	19	49	250.00	270.00	540.00	75.00	15.00		325.00	285.00	540.00
Foods, alcohols and beverages	679	173	215	9,329.00	2,506.00	2,433.00				9,329.00	2,506.00	2,433.00
Food preservatives and coloring matters	15	6	3	100.00	180.00	45.00				100.00	180.00	45.00
Medicines and similar articles	31	25	13	330.00	260.00	175.00				330.00	260.00	175.00
Miscellaneous chemical analyses and examinations		9	30		55.00	126.00					55.00	126.00
Fæces	10,456	12,144	51,736	78,839.00	221,944.00	1,231,693.00	925.00	228.00	242.00	79,764.00	222,172.00	1,231,935.00
Sputum	598	388	393	1,682.00	1,122.00	1,161.00	69.00	44.00	18.00	1,751.00	1,166.00	1,179.00
Blood	11,255	4,060	4,393	35,273.00	14,174.00	16,209.00	1,558.00	369.00	404.00	36,831.00	14,543.00	16,613.00
Blood culture		184	390		895.00	1,940.00		35.00	10.00		930.00	1,950.00
Widal test		314	588		942.00	1,752.00			12.00		942.00	1,764.00
Wassermann test		716	878		6,910.00	8,620.00		250.00	160.00		7,160.00	8,780.00
Leprosy		234	1,108		702.00	3,324.00					702.00	3,324.00
Urines		3,527	3,087		10,134.00	9,027.00		459.00	237.00		10,593.00	9,264.00
Gonococci	20,519	8,492	16,319	54,312.00	25,473.00	48,957.00	9.00	3.00		54,321.00	25,476.00	48,957.00
Necropsies	74	130	372	2,150.00	3,250.00	9,300.00				2,150.00	3,250.00	9,300.00
Histological examinations		317	243		3,160.00	2,430.00		10.00			3,170.00	2,430.00
Rabies		14	30									
Plague		12	43		36.00	129.00					36.00	129.00
Rats for plague		27,384	113,288		82,152.00	339,864.00					82,152.00	339,864.00
Miscellaneous biological work and examinations	57,170	774	1,638	170,785.00	2,461.00	8,355.00		6.00	28.00	170,785.00	2,467.00	8,383.00
Vaccine virus	2,405,115	1,321,124	2,537,800				28,042.41	13,211.24	25,378.00	28,042.41	13,211.24	25,378.00
Miscellaneous sera and preparations	1,644,255	1,057,050	4,956,287				3,166.36	4,033.90	10,645.57	3,166.36	4,033.90	10,645.57
Photographic work	1,387	587	1,363				1,538.43	925.20	1,338.73	1,538.43	925.20	1,338.73
Shop work	67	30	13				142.40	77.58	29.73	142.40	77.58	29.73
Total	4,160,112	2,438,915	7,691,511	409,742.00	421,928.00	1,728,987.00	36,908.60	20,013.92	38,503.03	446,650.60	441,941.92	1,767,490.03

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Patron.	Samples or units.			Free.			Cash.			Total.		
	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar 1914.
Bureau of Internal Revenue.				*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*
Standardization of weights			25						2.50			2.50
Foods, alcohols and beverages	15	13		375.00	550.00					375.00	550.00	
Medicines and similar articles	135	5	4	665.00	25.00	40.00				665.00	25.00	40.00
Miscellaneous chemical analyses and examinations	2			20.00						20.00		
Total	152	18	29	1,060.00	575.00	40.00			2.50	1,060.00	575.00	42.50
Bureau of Justice.												
Water, chemical		2						26.00			26.00	
Urines, clinical and toxicological analyses		1	12					75.00	220.00		75.00	220.00
Medicines and similar articles	5		13				25.00		85.00	25.00		85.00
Blood	1	1					3.00	75.00		3.00	75.00	
Miscellaneous biological work and examinations			3						155.00			155.00
Total	6	4	28				28.00	176.00	460.00	28.00	176.00	460.00
Bureau of Lands.												
Soils and similar substances	5			150.00						150.00		
Crude chemical and miscellaneous analyses	1			20.00						20.00		

Assays	1			2.00						2.00		
Total	7			172.00						172.00		
Bureau of Navigation.												
Coal analyses	1			15.00						15.00		
Cements	1	11					5.00	170.60		5.00	170.60	
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron, and steel		66						11.50			11.50	
Standardization of road materials	2						14.00			14.00		
Petroleum and products, copra, and similar materials	1			7.00						7.00		
Food preservatives and coloring matters	1			15.00						15.00		
Water:												
Chemical		7			35.00						35.00	
Biological	5	7		200.00	280.00					200.00	280.00	
Total	11	190		237.00	315.00		19.00	182.10		256.00	497.10	
Philippine Constabulary.												
Physical test of wire, twine, fiber, textile, paper, and similar articles	2	14	2				8.00	58.00	8.50	8.00	58.00	8.50
Fæces	5	5		37.00	15.00					37.00	15.00	
Sputum	11	8	1	24.00	24.00	3.00				24.00	24.00	3.00
Blood	3	1		153.00	75.00					153.00	75.00	
Wassermann reaction			1			10.00						10.00
Histological examinations		1			10.00						10.00	
Vaccine virus	34	2,000	2,150				0.34	20.00	21.50	0.34	20.00	21.50
Miscellaneous sera and preparations		150						60.00			60.00	
Total	55	2,179	2,154	214.00	124.00	13.00	8.34	138.00	30.00	222.34	262.00	43.00

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Patron.	Samples or units.			Free.			Cash.			Total.		
	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.
Philippine Exposition Board.				*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*
Photographic work	242		130				48.40		173.07	48.40		173.07
Shop work			20						522.59			522.59
Total	242		150				48.40		695.66	48.40		695.66
Philippine Library.												
Photographic work	60						13.80			13.80		
Bureau of Printing.												
Petroleum and products, copra, and similar materials	21			6.00						6.00		
Paper and similar materials	99	89	100	1,200.00	890.00	1,000.00				1,200.00	890.00	1,000.00
Miscellaneous chemical analyses and examinations		1			15.00						15.00	
Assays	1			6.00						6.00		
Photographic work	13						72.20			72.20		
Total	134	90	100	1,212.00	905.00	1,000.00	72.20			1,284.20	905.00	1,000.00
Bureau of Prisons.												
Soils and similar substances			1			30.00						30.00
Urines, clinical and toxicological analyses	2,024			6,072.00						6,072.00		
Foods, alcohols and beverages	1			3.00						3.00		
Miscellaneous chemical analyses and examinations	5			5.00						5.00		

Waters:												
Chemical		1			15.00						15.00	
Biological	34	13		750.00	520.00					750.00	520.00	
Fæces	18,452	9,410	67,183	55,730.00	28,230.00	1,455,989.00				55,730.00	28,230.00	1,455,989.00
Sputum	5,155	1,515	1,671	15,465.00	4,545.00	5,013.00				15,465.00	4,545.00	5,013.00
Blood	14,169	4,709	1,999	42,528.00	14,127.00	5,997.00				42,528.00	14,127.00	5,997.00
Widal test		2	6		6.00	18.00					6.00	18.00
Wassermann test		4	92		40.00	920.00					40.00	920.00
Leprosy		9	19		27.00	57.00					27.00	57.00
Urines		1,781	1,186		5,343.00	3,558.00					5,343.00	3,558.00
Gonococci		46	36		138.00	108.00					138.00	108.00
Necropsies	13	12	29	350.00	300.00	725.00				350.00	300.00	725.00
Histological examinations		2	5		20.00	50.00					20.00	50.00
Plague		1	1		3.00	3.00					3.00	3.00
Rats for plague		28	10		84.00	30.00					84.00	30.00
Miscellaneous biological work and examinations	108	17	61	241.00	51.00	191.00				241.00	51.00	191.00
Miscellaneous sera and preparations		25						25.00			25.00	
Total	39,961	17,575	72,299	121,144.00	53,449.00	1,472,689.00		25.00		121,144.00	53,474.00	1,472,689.00
Bureau of Public Works.												
Metals and alloys	1		3	4.00		20.00				4.00		20.00
Coal analyses			1			15.00						15.00
Crude chemical and miscellaneous analyses	7						104.00			104.00		
Cements	3,889	1,832	1,587				4,250.20	2,784.80	2,306.80	4,250.20	2,784.80	2,306.80
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron, and steel	15		22				50.00		64.00	50.00		64.00
Standardization of road materials	20		7				200.50		87.65	200.50		87.65
Paints, varnishes, and linseed oils	1		4				9.00		36.00	9.00		36.00

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Patron.	Samples or units.			Free.			Cash.			Total.		
	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.
Bureau of Public Works—Contd.				*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*
Miscellaneous chemical analyses and examinations	1		1	2.50		33.00				2.50		33.00
Waters:												
Chemical	95	72	139	3,595.00	2,880.00	2,800.00				3,595.00	2,880.00	2,800.00
Biological	70	74	113	3,240.00	2,960.00	4,400.00				3,240.00	2,960.00	4,400.00
Photographic work	219	495					188.80	372.15		188.80	372.15	
Total	4,318	2,473	1,877	6,841.50	5,840.00	7,268.00	4,802.50	3,156.95	2,494.45	11,644.00	8,996.95	9,762.45
Bureau of Quarantine Service.												
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron, and steel	2						14.00			14.00		
Urine, clinical and toxicological analyses	3			7.00						7.00		
Fæces	5,545	2,726	6,762	138,581.00	68,150.00	169,050.00				138,581.00	68,150.00	169,050.00
Sputum	2			6.00						6.00		
Blood	2			6.00						6.00		
Leprosy			2			6.00						6.00
Plague			3			9.00						9.00
Rats for plague		152	39		456.00	117.00					456.00	117.00
Miscellaneous biological work and examinations	683			2,055.00						2,055.00		

Vaccine virus	7,600	1,700	6,350				76.00	17.00	63.50	76.00	17.00	63.50
Total	13,837	4,578	13,156	140,655.00	68,606.00	169,182.00	90.00	17.00	63.50	140,745.00	68,623.00	169,245.50
Bureau of Science.												
Metals and alloys	5	1	8	88.50	20.00	43.00				88.50	20.00	43.00
Rocks, minerals, natural pigments, and similar substances	12	3		129.50	24.00					129.50	24.00	
Clays, shales, limestones, limes, wall plasters, cements, and slags	21	25	5	354.00	199.60	115.00				354.00	199.60	115.00
Coal analyses			2			30.00						30.00
Calorimetric tests of fuels		2	1		40.00	20.00					40.00	20.00
Crude chemical and miscellaneous analyses	4	1	2	15.25	5.00	30.00				15.25	5.00	30.00
Standard solutions	7	14	25	35.00	136.00	167.00				35.00	136.00	167.00
Physical test of wire, twine, fibers, textiles, paper, and similar articles	1			4.00						4.00		
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	3	7		3.00	14.00					3.00	14.00	
Standardization of road materials	16			99.50						99.50		
Standardization of units of measures; miscellaneous		19			1.90						1.90	
Urine, clinical and toxicological analyses	1			3.00						3.00		
Petroleum and products, copra, and similar materials	10	1	15	187.50	20.00	75.00				187.50	20.00	75.00
Paints, varnishes, and linseed oils	3			26.00						26.00		
Paper and similar materials			3			30.00						30.00

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Patron.	Samples or units.			Free.			Cash.			Total.		
	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.
Bureau of Science—Continued.				*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*
Foods, alcohols and beverages	127			1,270.00						1,270.00		
Miscellaneous chemical analyses and examinations	19	2		35.00	15.00					35.00	15.00	
Waters:												
Chemical	6	2	9	105.00	80.00	145.00				105.00	80.00	145.00
Biological	61	4	399	2,440.00	160.00	15,960.00				2,440.00	160.00	15,960.00
Assays	26		8	8.00		19.00				8.00		19.00
Fæces			73			1,825.00						1,825.00
Blood	1			10.00						10.00		
Rabies			5									
Miscellaneous biological work and examinations			1			5.00						5.00
Photographic work	681	275	1,822	1,056.10	76.30	593.00				1,056.10	76.30	593.00
Shop work	156	147	150	2,582.32	1,050.13	1,212.16				2,582.32	1,050.13	1,212.16
Total	1,160	503	2,528	8,451.67	1,841.93	20,269.16				8,451.67	1,841.93	20,269.16
Bureau of Supply.												
Metals and alloys	5		6	43.00		24.00				43.00		24.00
Rocks, minerals, natural pigments, and similar substances	1			10						10.00		
Coal analyses	39			585.00						585.00		
Calorimetric tests of fuels	23			460.00						460.00		

Crude chemical and miscellaneous analyses	7	4	20	30.00	40.00	181.00	108			138.00	40.00	181.00
Standard solutions		1						1.50			1.50	
Physical tests of wire, twine, fibers, textiles, paper, and similar materials	27		29				106.00		82.00	106.00		82.00
Cements	5,379	2,838	4,888				3,564.00	2,642.00	4,190.00	3,564.00	2,642.00	4,190.00
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	13	15	5				52.00	12.00	8.00	52.00	12.00	8.00
Standardization of road materials		1	1					15.00	15.00		15.00	15.00
Standardization of units of measures:												
Lengths	96	349	171			0.10	67.20	245.50	88.50	67.20	245.50	88.60
Capacities	150	31	308	15.00				18.00	88.70	15.00	18.00	88.70
Weights	660	890	751	66.00				89.00	77.45	66.00	89.00	77.45
Miscellaneous	202	26	28	2.50				7.50	12.00	2.50	7.50	12.00
Essential oils and essences	1	1		15.00	7.50					15.00	7.50	
Petroleum and products, copra, and similar materials	20	7	3	140.00	48.00	47.00				140.00	48.00	47.00
Paints, varnishes, and linseed oils	27	31	17	15.00		15.00	178.50	142.50	145.00	193.50	142.50	160.00
Paper and similar materials	1			3.00						3.00		
Foods, alcohols and beverages	13	24	45	96.00	72.00	171.00				96.00	72.00	171.00
Medicines and similar articles	8		4	75.00		30.00				75.00		30.00
Miscellaneous chemical analyses and examinations		1	10		5.00	77.00					5.00	77.00
Water:												
Chemical	15	1	8	225.00	15.00	120.00				225.00	15.00	120.00
Biological	20		12	750.00		480.00				750.00		480.00
Miscellaneous biological work and examinations	2		1	20.00		50.00				20.00		50.00

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Patron.	Samples or units.			Free.			Cash.			Total.		
	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1914.	Six months ended Dec. 31, 1913.	Calendar year 1914.
Bureau of Supply—Continued.				*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*
Vaccine virus		3,000						90.00			90.00	
Mallein		20	6					2.00	6.00		2.00	6.00
Miscellaneous sera and preparations	20,000		60,000				20.00		60.00	20.00		60.00
Total	26,709	7,240	66,313	2,550.50	187.50	1,195.10	4,095.70	3,265.00	4,772.65	6,646.20	3,452.50	5,967.75
The Sales Agency.												
Photographic work	12						2.40			2.40		
University of the Philippines.												
Standard solutions			2						2.00			2.00
Urine, clinical and toxicological analyses	5			15.00						15.00		
Foods, alcohols and beverages	9	18		90.00				36.67		90.00	36.67	
Fæces		180	126		4,500.00	3,150.00					4,500.00	3,150.00
Rabies			1									
Plague			18			54.00						54.00
Miscellaneous biological work and examinations	4			9.00						9.00		
Miscellaneous sera and preparations	34	20,000					2.00	20.00		2.00	20.00	
Photographic work	651	104	480				386.66	67.00	219.15	386.66	67.00	219.15
Shop work	1	28	7				3.55	53.62	45.76	3.55	53.62	45.76
Total	704	20,330	634	114.00	4,500.00	3,204.00	392.21	177.29	266.91	506.21	4,677.29	3,470.91

Weather Bureau.												
Photographic work	62						12.40			12.40		
City of Manila.												
Clays, shales, limestone, limes, wall plasters, cements, and slags			2						6.00			6.00
Crude chemical and miscellaneous analyses	2	1	7				45.40	15.00	78.00	45.40	15.00	78.00
Cements	15	84	119				50.00	319.80	445.20	50.00	319.80	445.20
Standardization of road materials	3		1				25.00		15.00	25.00		15.00
Foods, alcohols and beverages		2						20.00			20.00	
Medicines and similar articles	6						30.00			30.00		
Miscellaneous chemical analyses and examinations		1	1					10.00	10.00		10.00	10.00
Blood	2	6					225.00	450.00		225.00	450.00	
Waters, biological			627			19,590.00						19,590.00
Miscellaneous biological work and examinations	1		5				25.00		68.00	25.00		68.00
Mallein			6						6.00			6.00
Miscellaneous sera and preparations	141,000	80,500	189,040				141.00	80.50	193.00	141.00	80.50	193.00
Photographic work		6						19.50			19.50	
Total	141,029	80,600	189,808			19,590.00	541.40	914.80	821.20	541.40	914.80	20,411.20
Provinces and municipalities.												
Metals and alloys			1						48.00			48.00
Rocks, minerals, natural pigments, and similar substances	1						17.00			17.00		
Soils and similar substances	1						5.00			5.00		
Crude chemical and miscellaneous analyses			2						14.00			14.00

TABLE 11.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Patron.	Samples or units.			Free.			Cash.			Total.		
	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.
Provinces and municipalities—Continued.				*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*
Cements	113	5	38				301.45	19.35	142.50	301.45	19.35	142.50
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	15	22	11				43.00	39.00	53.00	43.00	39.00	53.00
Standardization of road materials	10		6				114.00		52.50	114.00		52.50
Medicines and similar articles	4	1	1				5.00	10.00	10.00	5.00	10.00	10.00
Water:												
Chemical	3	3	1				95.00	120.00	40.00	95.00	120.00	40.00
Biological	3	2	1				120.00	80.00	40.00	120.00	80.00	40.00
Vaccine virus	3,800	2,100	65,250				114.00	63.00	3,077.50	114.00	63.00	3,077.50
Miscellaneous sera and preparations	33,000						84.60			84.60		
Photographic work		20	37					3.30	27.20		8.30	27.20
Total	36,950	2,153	65,348				899.05	339.65	3,504.70	899.05	339.65	3,504.70
United States Army and Navy.												
Metals and alloys	3		3				37.00		80.00	37.00		80.00
Clays, shales, limestones, limes, wall plasters, cements, and slags	2						10.00			10.00		
Coal analyses	1	1	11				15.00	6.00	151.00	15.00	6.00	151.00

Calorimetric tests of fuels		4	3					86.00	60.00		86.00	60.00
Waters, chemical	2		1				30.00		40.00	30.00		40.00
Standard solutions	3						10.00			10.00		
Physical tests of wire, twine, fibers, textiles, paper, and similar articles	30						39.00			39.00		
Cements	120	202	126				823.90	324.40	308.00	823.90	324.40	308.00
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	7						24.00			24.00		
Standardization of road materials	1						5.00			5.00		
Urine, clinical and toxicological analyses			2						50.00			50.00
Essential oils and essences	6						54.00			54.00		
Petroleum and products, copra, and similar materials	9		1				133.00		16.00	133.00		16.00
Paints, varnishes, and linseed oils			14						108.00			108.00
Foods, alcohols and beverages	18	3	7	170.00			98.00	13.00	96.00	268.00	13.00	96.00
Medicines and similar articles	9						8.00			8.00		
Miscellaneous chemical analyses and examinations	11	2					82.00	50.00		82.00	50.00	
Blood cultures		1						3.00			3.00	
Vaccine virus	14,064	7,324	22,172				478.90	254.40	717.80	478.90	254.40	717.80
Mallein	240	491	328				240.00	491.00	328.00	240.00	491.00	328.00
Miscellaneous sera and preparations	573,608	245,831	528,831				887.30	1,112.00	2,184.35	887.30	1,112.00	2,184.35
Photographic work	5						30.00			30.00		
Shop work			1						5.18			5.18
Miscellaneous work		2						1.00			1.00	
Total	588,139	253,861	551,500	170.00			3,005.10	2,340.80	4,144.33	3,175.10	2,340.80	4,144.33

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Patron.	Samples or units.			Free.			Cash.			Total.		
	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.
Miscellaneous.				*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*
Metals and alloys	19	9	28				172.50	58.51	308.50	172.50	58.51	308.50
Rocks, minerals, natural pigments, and similar substances	1						3.00			3.00		
Clays, shales, limestones, limes, wall plasters, cements, and slags	31	6	3				255.50	60.00	21.00	255.50	60.00	21.00
Fertilizers	11	7	12				108.00	59.00	132.00	108.00	59.00	132.00
Soils and similar substances	2	5	30				30.00	45.00	693.00	30.00	45.00	693.00
Coal analyses	16	2	8				158.00	23.00	125.00	158.00	23.00	125.00
Calorimetric tests of fuels	7	1	3				140.00	20.00	60.00	140.00	20.00	60.00
Crude chemical and miscellaneous analyses	5	6	49				49.00	122.00	197.50	49.00	122.00	197.50
Standard solutions		3	3					19.00	27.00		19.00	27.00
Cements	38	22	59				134.50	95.90	243.70	134.50	95.90	248.70
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel	6	26	48				85.00	86.00	205.00	85.00	86.00	205.00
Standardization of road materials, etc	7						42.00			42.00		

Standardization of units of measures:												
Capacities	4		4				4.00		10.70	4.00		10.70
Miscellaneous	5	6	13				10.00	24.00	42.00	10.00	24.00	42.00
Urines, clinical and toxicological analyses	47	21	63				130.00	81.00	199.00	130.00	81.00	199.00
Essential oils and essences	30	16	13				219.00	120.00	89.50	219.00	120.00	89.50
Petroleum and products, copra, and similar materials	7	2	10				44.50	90.00	73.50	44.50	90.00	73.50
Paints, varnishes, and linseed oils	9	2	3				124.00	30.00	30.00	124.00	30.00	30.00
Gums, resins, and similar materials	2	8					10.00	29.00		10.00	29.00	
Gastric juice, clinical examinations			3						15.00			15.00
Foods, alcohols and beverages	166	114	249				816.50	1,004.70	788.00	816.50	1,004.70	788.00
Food preservatives and coloring matters	3	1	2				14.00	6.00	4.00	14.00	6.00	4.00
Medicines and similar articles	3	3	2				25.00	15.00	45.00	25.00	15.00	45.00
Miscellaneous chemical analyses and examinations	14	3	23				96.00	29.00	90.00	96.00	29.00	90.00
Assays	279	219	403				598.67	360.50	653.45	598.67	360.50	653.45
Waters:												
Chemical	19	7	13				515.00	185.00	285.00	515.00	185.00	285.00
Biological	17	5	2				630.00	210.00	280.00	630.00	210.00	280.00
Fæces	72	37	346				222.00	113.00	1,129.00	222.00	113.00	1,129.00
Sputum	14	8	30				42.00	24.00	90.00	42.00	24.00	90.00
Blood	108	3	6				1,030.00	9.00	18.00	1,030.00	9.00	18.00
Blood culture			2						10.00			10.00
Widal test			5						21.00			21.00
Wassermann test		78	288					780.00	2,880.00		780.00	2,880.00
Leprosy			3						9.00			9.00
Urines		1	2					10.00	5.00		10.00	5.00
Gonococci	3	3	24				9.00	9.00	72.00	9.00	9.00	72.00

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Patron.	Samples or units.			Free.			Cash.			Total.		
	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.	Fiscal year 1913.	Six months ended Dec. 31, 1913.	Calendar year 1914.
Miscellaneous—Continued.				*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*
Histological examinations		2	8					20.00	80.00		20.00	80.00
Miscellaneous biological work and examinations	8	5	46				60.00	20.00	297.50	60.00	20.00	297.00
Vaccine virus	3,174	421	2,613				163.90	20.90	124.75	163.90	20.90	124.75
Mallein	2		175				2.00		175.50	2.00		175.50
Miscellaneous sera and preparations	407,321	333,215	789,932				986.71	954.90	1,926.90	986.71	954.90	1,926.90
Photographic work	7,077	5,650	9,496				3,634.30	2,483.35	2,558.35	3,634.30	2,483.35	2,558.35
Natural history specimens	84	1	8				127.60	2.00	81.24	127.60	2.00	81.24
Shop work	24	13	17				58.49	107.30	550.97	58.49	107.30	550.97
Miscellaneous work	31	26	52				152.14	5,028.60	8,081.52	152.14	5,028.60	8,081.52
Sales of publications							6,364.71	1,881.14	3,433.16	6,364.71	1,881.14	3,433.16
Refunded, work not done, etc. (deducted)							(137.00)	(438.81)	(82.75)	(137.00)	(438.81)	(82.75)
Power, gas, etc							34,265.70	16,907.03	31,995.70	34,265.70	16,907.03	31,995.70
Reimbursement of traveling expenses, etc							393.60			393.60		
Total	418,669	339,957	804,104				51,789.32	30,704.02	58,079.19	51,789.32	30,704.02	58,079.19
Grand total	5,990,178.33	3,301,226.97	9,599,175.33	693,009.67	558,798.43	3,426,273.76	104,880.62	64,489.41	114,738.45	797,890.29	623,287.84	3,541,012.21

TABLE III.—*Comparative statement showing expenditures and income during the semifiscal year 1914 (July 1 to December 31, 1913) and during the new fiscal year 1914, as compared with the fiscal year 1913 (July 1, 1912, to June 30, 1913).*

EXPENDITURES.

Item.	Fiscal year 1913.	Semifiscal year 1914.	New fiscal year 1914.
Apparatus, supplies, etc.:	*Pesos.*	*Pesos.*	*Pesos.*
Miscellaneous supplies and chemicals	17, 189. 27	8, 212. 40	22, 873. 86
Apparatus	4, 430. 87	1, 567. 69	1, 762. 59
Supplies for power plant, oil, coal, etc	27, 722. 84	6, 062. 04	26, 885. 83
Small animals, feed, etc	2, 012. 39	515. 86	1, 076. 42
Large animals, feed, etc	4, 231. 49	2, 253. 72	5, 007. 18
Office supplies	3, 832. 58	1, 431. 80	2, 392. 18
Photographic supplies	3, 672. 46	1, 771. 83	2, 829. 48
Books, subscriptions, etc	8, 216. 35	5, 578. 19	9, 043. 03
Total	71, 308. 25	27, 393. 53	71, 870. 57
Transportation and freight, etc.:			
Transportation, travel expenses, per diems, launch hire, etc	13, 421. 20	3, 795. 68	10, 134. 90
City transportation	2, 175. 15	1, 271. 11	3, 453. 54
Freight	1, 134. 66	493. 17	980. 09
Total	16, 731. 01	5, 559. 96	14, 568. 53
Miscellaneous:			
Telephones and fire alarm boxes	1, 518. 09	802. 10	1, 458. 97
Postage, telegrams, and cablegrams	3, 181. 79	1, 208. 03	3, 473. 15
Repairs to apparatus, furniture, etc	828. 94	1, 035. 76	712. 92
Laundry	423. 21	267. 28	486. 22
Printing and binding	26, 024. 49	18, 269. 87	28, 695. 67
Advertising	931. 04	83. 46	268. 02
Incidentals, including operation of aquarium, building maintenance, etc	2, 075. 25	1, 260. 37	12, 299. 72
Museum specimens	4, 207. 94	4, 620. 45	19, 688. 18
Total	39, 190. 75	27, 547. 32	67, 082. 85
Salaries and wages:			
Salaries and wages	234, 083. 11	126, 176. 01	173, 729. 61
Transportation and expenses en route foreign country to Manila	3, 508. 35	4, 910. 13	624. 54
Accrued leave and half salary	20, 536. 28	49, 687. 27	50, 384. 12
Total	258, 127. 74	180, 773. 41	224, 738. 27
Grand total	385, 357. 75	241, 274. 22	378, 260. 22
Accounts payable and outstanding obligations paid during the year	69, 776. 87	43, 336. 63	51, 738. 13
	455, 134. 62	284, 610. 85	429, 998. 35

TABLE III.—*Comparative statement showing expenditures, etc.*—Continued.

INCOME.

Item.	Fiscal year 1913.	Semifiscal year 1914.	New fiscal year 1914.
	Pesos.	*Pesos.*	*Pesos.*
Receipts from operation	104,880.62	64,489.41	115,486.73
Prior year income	(51.57)	(1,843.83)	(838.20)
Sales of supplies	954.74	391.53	488.82
Sales of fixed assets	1,705.21	898.46	2,716.45
Deferred income		12,000.00	
Total	107,489.00	75,936.07	117,853.80
Appropriation account:			
Allotted or appropriated	240,000.00	323,000.00	381,084.00
Accounts payable	23,499.60	5,836.18	68,586.98
Brought forward or restored from previous fiscal years to cover contingent obligations	46,384.70	59,630.30	9,834.35
Total	409,884.30	388,466.48	459,505.33

MISCELLANEOUS ACCOUNTS.

Tiqui-tiqui distribution, Act No. 2376:	*Pesos.*
Available, Feb. 28, 1914	6,000.00
Expended	943.36
Balance	5,056.64
Public works: Alterations to boiler, sec. 4, Act No. 1989:	
Available, Jan. 1, 1914	7,031.64
Expended	6,237.64
Balance	794.00
Aquarium, sec. 4, Acts Nos. 1902 and 1989:	
Available, Jan. 1, 1914	55.91
Expended	55.91
Balance	
Library equipment, Act No. 1988:	
Available, Jan. 1, 1914	1,572.57
Expended	
Balance	1,572.57
Replacement fund:	
Available, Aug. 28, 1914	1,352.46
Expended	8.25
Balance	1,344.21
Guaranty fund:	
Applicable to accounts, Jan. 1, 1914	2,008.22
Applicable to accounts, Jan. 1, 1915	1,648.91

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THE PHILIPPINE JOURNAL OF SCIENCE

ALVIN J. COX, M. A., PH. D.

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FOURTEENTH ANNUAL REPORT OF THE DIRECTOR OF THE BUREAU OF SCIENCE

PHILIPPINE ISLANDS

TO THE HONORABLE
THE SECRETARY OF THE INTERIOR

BY

ALVIN J. COX
DIRECTOR OF THE BUREAU OF SCIENCE

FOR THE YEAR ENDING
DECEMBER 31, 1915

MANILA
BUREAU OF PRINTING
1917

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Fourteenth Annual Report of the Director of the Bureau of Science

Philippine Islands

TO THE HONORABLE
THE SECRETARY OF THE INTERIOR

BY

Alvin J. Cox

DIRECTOR OF THE BUREAU OF SCIENCE

FOR THE YEAR ENDING
DECEMBER 31, 1915

MANILA
BUREAU OF PRINTING
1917

FOURTEENTH ANNUAL REPORT OF THE DIRECTOR OF THE BUREAU OF SCIENCE

The GOVERNMENT OF THE PHILIPPINE ISLANDS,
DEPARTMENT OF THE INTERIOR,
BUREAU OF SCIENCE,
Manila, January 1, 1916.

SIR: I have the honor to submit the following account of the Bureau of Science and the work performed therein from January 1 to December 31, 1915. In the space which I propose to devote to the purpose it will be scarcely possible to mention all its activities, but I shall briefly discuss the Bureau's important, and some of the less familiar, lines of work and indicate its needs.

The demands upon the Bureau of Science have increased during this year as they have during each preceding year. The amount of work done for pay has amounted to ₱98,197.62 for the year as compared with ₱104,880.62 for 1914, ₱96,634.81 for 1913, ₱88,191.18 for 1912, and ₱81,510.12 for 1911. The increase in routine examinations is shown by the following table:

	1907	1911	1915
Chemical and physical analyses and tests of metals, minerals, clays, cements, fertilizers, soils, fuels, waters, papers, gums and resins, foods, drugs, etc	3,064	9,193	10,765
Examinations of fæces, urines, blood, sputum, gonococci, rabies, rats for plague, and miscellaneous bacteriological examinations	26,449	35,645	169,270
Total analyses, tests, and examinations	29,513	44,838	180,035
Available appropriation	₱381,838.28	₱512,250.76	₱379,890.00

In spite of a large increase in the amount of routine work during the last year and a decrease in available appropriation and in the face of other adverse circumstances, I consider it a great credit to the employees of this institution that they have been able to carry on so much work, all tending to improve sanitary conditions, to develop the valuable resources of the

Philippine Islands, and to develop both old and new industries—work which should be carried on at all times. I desire to thank each and every employee for his coöperation and devotion to duty.

Many of the valuable resources of the Philippine Islands are insufficiently, or not at all, developed. I have endeavored to direct the work of the Bureau of Science in such a way that a study of the problems connected with some of these should be in progress at all times. There is a necessity for work merely to arouse further interest in Philippine resources and to stimulate the development of both old and new industries. Profitable modifications of old methods are not always readily accepted by the people most concerned and should be thoroughly demonstrated.

The Bureau of Science is charged by law with the performance of work for all branches of the Philippine Government requiring laboratory facilities. There are continually more and more demands upon the Bureau of Science for consultation work such as mine examinations, advice such as is given by a consulting chemist, etc. There is scarcely a day when I am not conferred with regarding one or more commercial problems. There are very few technical men in the Archipelago outside of the Government, and there are few industries developed to the extent where they can afford the continuous services of a technical man; the Government should recognize this and provide sufficient personnel for special consultation work, which will prevent loss to the producer, the manufacturer, and the commerce of the country.

NECESSITY FOR SYSTEMATIC WORK

Botanical and zoölogical work, especially systematic work, involving the collection, preservation, and classification of specimens, seems to many persons to be as impracticable and unproductive as the formation of a collection of postage stamps—a pleasant hobby. A botanical collection may be taken as an example, for the same arguments apply to collections of plant specimens as are applicable to bird, insect, and other zoölogical collections. A herbarium of properly named specimens bears somewhat the same relation to a study of timber trees, medicinal plants, rubber-producing trees and vines, fibers, resins, dye woods, etc., that a dictionary does to the production of an essay, an editorial, or the description of a piece of machinery. Were the vegetation of the Philippine Islands well known, there would have been absolutely no justification for the Bureau of Science or

other branch of the Government to have built up a general herbarium or to have given much attention to systematic work. However, little work had been done. There was, and is now, except in the Bureau of Science, absolutely no institution in the world where Philippine Islands specimens could be sent for identification, yet classification and accurate identification of material must precede all economic investigations. The material in the Bureau of Science herbarium has been used in the classification and identification of the classes of economic plants enumerated above and of all other known Philippine species. Groups of plants that are known to be of no economic value, such as ferns, mosses, lichens, orchids, etc., are not studied by the employees of the Bureau of Science. All plants of a country, except those of such groups, must be studied, else many economic plants would not be collected and identified. To work solely on plants known to be of economic value would be analogous to compiling a city directory and including only the names of persons who were of value to the city. The fact that a plant is related to another, known to yield a valuable product, may lead to the discovery of a new economic source of that product.

The publication of the results of the study of a collection is as important as its formation. The actual as well as scientific value of any collection is potential until the specimens have been identified by specialists and have become the data upon which systematic reports are based. The most valuable specimens in any collection are the "types." A type is the specimen selected by an author to represent a new species described by him. He may have any number of specimens before him, but he should draw his description from a single specimen which he should designate as "type." In the best taxonomic work of the present time the collection serial number of the type and other data serving to locate it are given. Types add to the value of a collection not only because they are the best possible means of identifying other specimens, but also because a type is unique and, therefore, beyond price. The value of a collection is being continually enhanced in the hands of a man who compares his specimens with original descriptions and with the types or cotypes and describes and publishes the new species and genera he finds and records new facts in the distribution of known species. On the other hand, the identical collection cared for by a man who does no more than sort the specimens into their families or genera rapidly decreases in value because the percentage of types and historical material rapidly decreases. The increase in value of a specimen that has been compared with

the type of its species or that has been labeled by a specialist is somewhat similar to that which takes place in a meter rod when it is compared with the standard meter measure now kept at Sevres, France. The collections of the Bureau are very valuable on account of the high percentage of its types, cotypes, and compared specimens.

Prior to 1900 practically no botanical work of importance had been accomplished in the Philippine Islands. Systematic work had to precede all other lines of botanical investigation. For example, without such work the present commercial classification of Philippine timbers would have been absolutely impracticable. The botanical material of the Bureau of Science has been turned over for identification to specialists wherever they could be found willing to work on the material. The lichens have been sent to a man in Finland, the mosses to another man in Finland, the hepatics to one in Germany, the orchids to one in America, and so on for a score of groups. Thus the Philippine Government has had the benefit of the trained services of numerous specialists in England, Germany, Switzerland, Finland, Holland, Denmark, and the United States merely by sending a set of duplicate specimens. Only those groups for which no specialists could be found have been worked in Manila.

PUBLICATION

The publication of the results of the study of a collection of biological specimens and of all other investigations is absolutely necessary. In my last annual report I pointed out that high-grade character in publication could not be maintained by bulletin issues. For the same reason, among others, the Philippine Journal of Science was started in 1906. The United States Department of Agriculture followed the example of the Bureau of Science when it established the Journal of Research in 1914. Besides improving the character of the work and avoiding the confusion that results from a multiplicity of series of publications, there are many reasons, any one of which justifies the publication of the Philippine Journal of Science, as follows:

1. The larger part of the current serial literature in the Bureau of Science library has been received in exchange for the Philippine Journal of Science. The value of these publications, together with the cash sales of the Philippine Journal of Science, makes the latter practically self-supporting. A series of bulletins issued either free or at cost has very little exchange value and is not acceptable to many institutions.

2. If there were not a single advantage to the public in having

scientific articles in printed rather than in manuscript form, there is a saving to the Philippine Government in salaries of more than the cost of printing the Philippine Journal of Science in the stimulus that the prospect of future publication of worthy articles gives to the scientists.

The research work of the Bureau of Science costs practically nothing. The men now employed are necessary for the regular work. With the stimulus of publication, the men now are always busy during office hours and often work hours and hours overtime on research work. This is not done for the Bureau, but for the man himself, and the Philippine Islands profit.

3. The publication of the Philippine Journal of Science gives a standing to the institution and the Government which could not be obtained in any other way. The China Medical Journal of November, 1915, speaking of its exchanges, under the heading of the Philippine Journal of Science, says:

> The contents of this number of the Journal are of the usual high standard of scientific interest. [25 printed lines discussing the published papers.] The paper on the "Treatment of Infantile Beriberi," by Albert, is of so much interest in connection with our own discussion of Beriberi, that the JOURNAL has taken the liberty of reprinting it. The record of the Eleventh Annual Meeting of the Philippine Islands Medical Association, held in 1914, completes this valuable number.

On account of the Philippine Journal of Science we have been able to attract and retain men of ability whom we should not have been able to get in any other way.

4. The Philippine Journal of Science is known all over the world. In many institutions, when I was in the United States on leave and introduced myself, I received the reply: "Yes, I know the Philippine Journal of Science."

5. It is impossible for any one to cull accurate information from another's rough notes. The Philippine Journal of Science is a permanent record of the best of the work of former employees of the Bureau of Science. The economy of such a publication is shown by the time saved in answering inquiries by this and other offices of the Government. A great deal of information of former employees of the Philippine Government has been lost because no adequate record was made.

6. The Philippine Journal of Science is intended as the scientific organ of the Philippine Government, and any worthy articles containing original material regarding Philippine problems are printed; thus Philippine material is brought together in one place.

7. We are attempting to train here in the Philippine Islands a corps of Filipino scientists. The only standard medium of

publication available to the corps of assistants now being trained in the Bureau of Science and in the University of the Philippines is the Philippine Journal of Science, which has a well-established international reputation in the scientific world. In this connection attention is called to the fact that in many of the large cities of the East—Tokyo, Shanghai, Singapore, Batavia, Buitenzorg, Calcutta, Rangoon, Bombay, and many others—scientific publications are issued. Practically without exception these scientific publications are supported wholly or in part by the governments of the different countries. It is true that some are published by scientific societies, but invariably the scientific society receives a subsidy from the local government to cover, at least in part, the cost of publication and distribution.

FAR EASTERN ASSOCIATION OF TROPICAL MEDICINE

The fourth biennial congress of the Far Eastern Association of Tropical Medicine will meet in Batavia in June, 1916. The stimulus of thought and the benefit derived from an organization of this kind is very great, not only to the delegates, but also to the institutions which they represent, especially in this part of the world where the scientific worker is isolated to a great extent. It is hoped, therefore, that this institution can be represented at the sessions.

PHILIPPINE ISLANDS MEDICAL ASSOCIATION

No meeting of the Philippine Islands Medical Association was held in 1915.

CONGRESS OF PHYSICIANS AND PHARMACISTS

The third congress of physicians and pharmacists will be held in Manila from February 7 to 11, 1916, inclusive. The meeting is held under the auspices of the Colegio Medico-Farmaceutico of the Philippine Islands. The Bureau of Science is to contribute seventeen papers to be read at the various sections as follows:

Food inspection, by H. C. Brill.
Estudio bacteriologico de las aguas potables en Pasig, by Ariston Guzman.
Parasitos intestinales del hombre en Filipinas, by Ariston Guzman.
Manila swimming pools from a bacteriological standpoint, by C. E. Gabel.
Biological examination of Manila water supply, by C. E. Gabel.
Fish as a food supply, or the sea harvest, by Alvin Seale.
Fake medical appliances, by T. Dar Juan.
Industria del curtido de pieles, by V. Q. Gana.
Water analysis in the field, by George W. Heise.
Analytical standards for Philippine waters, by George W. Heise.
Water supply for the city of Iloilo, by George W. Heise.

The chemical constituents of chaulmoogra oil, by H. C. Brill.
The ferric chloride test for salycilic acid, by H. C. Brill.
The chemical purification of swimming pools, by George W. Heise and R. H. Aguilar.
A study of mothers' milk, by Ariston Guzman.
Investigation of the medicinal plants of the Philippines, by E. D. Merrill.
Some vegetables grown in the Philippines, by F. Agcaoili.

INSTRUCTIONS TO DISTRICT HEALTH OFFICERS

The Director of Health conceived the idea that his district health officers could do their work better, if they had a little idea of the work which is carried on in the Bureau of Science, and would know better how to prepare specimens to be sent to the Bureau of Science for examination, if they took a short course in this work. The Director of Health discussed his plan with the undersigned, and it was approved. The bacteriologists of the Bureau of Science began the instruction on October 11, 1915, when Dr. Eugenio Hernando, district health officer of Bulacan; Dr. Rafael Villafranca, district health officer of Tayabas; Dr. Vicente Rivera, district health officer of Laguna; and Dr. Antonio Fernando, district health officer of Nueva Ecija, were detailed to the Bureau of Science for six weeks of laboratory and practical instruction. These men learned better how to prepare materials and reviewed the most frequently used bacteriological examinations.

STANDARDIZATION OF SUPPLIES

For several years the Bureau of Science has been urging the desirability of standardization of supplies and the establishment of certain qualities of material for Government use. The standardization of measuring apparatus in the Islands is well in hand, and as pointed out in my last annual report, as a result of the examination by this Bureau during the past seven years certain materials purchased by the Government were standardized and purchased under specifications, and in each instance a remarkable increase in the quality has been noted. On June 24, 1914, his Excellency, the Governor-General, issued Executive Order No. 62, appointing a Committee on Standardization of Supplies. Except the Director of the Bureau of Science, all the other members of this committee have resigned during the past year, and I was away on leave in the United States for a period of several months. Since my return the committee has been reorganized and is now endeavoring to eliminate inferior materials and to systematize, classify, and effect economy in the purchase of general supplies. Standardization in chemicals refers to purity; in machine tool equipment and accessories it

refers not only to cost and quality but to interchangeability, that is, uniformity of dimensions of machine parts. The whole world now recognizes the necessity of standardization, if time is to be saved and if operation and production are to be kept at a low cost. There is a large saving to the Government by the elimination of a large assortment of different articles serving the same purpose. It will take a long time to pass on the thousands of articles needed by the Government. The war in Europe has interfered with our sources of supplies. Prices of staple articles have increased from 10 to 200 per cent, and of certain chemicals, from 500 to 1,000 per cent; freight rates are steadily rising; and prices are continually advancing. It is anticipated that the work of the committee will be extended to include the investigation and redistribution of serviceable supplies, materials, and equipment now on hand in the various branches of the service. The successful solution of many of our local problems concerning supplies and materials must be solved by local research. The available information on many of these subjects is very meager, and only a few general results are applicable to the Philippines; for example, there is practically no material of construction used in the Islands upon which there is not a great deal of work to be done. Every branch of the Government that has to deal with construction materials realizes the importance of studies of this kind and the limited provision that has been placed at the disposal of the Bureau of Science for carrying it on.

ELECTROLYSIS COMMITTEE

The Electrolysis Committee consists of the Superintendent of Water Supply and Sewers of the city of Manila, the City Electrician, the City Boiler Inspector, the Director of the Bureau of Science, and a representative of the Manila Electric Railroad and Light Co., of the Philippine Islands Telephone and Telegraph Company, and of the Manila Gas Corporation, respectively. Many of the members of the old committee have left Manila, and a new committee is soon to be appointed to carry on the work. Many interesting developments have occurred in the past, and the interesting problem of determining the causes of several aggravated cases of boiler condenser-tube corrosion in local factories was presented for solution. The trouble in some cases was attributed to stray currents.

MANUFACTURE OF EXTRACT OF TIQUI-TIQUI

Under the provisions of Act No. 2376 the Bureau of Science has continued its work of preparing extract of tiqui-tiqui for

the treatment of infantile beriberi. The work is of great practical importance. A stock has been continually kept on hand, and up to the close of the year 200 liters of extract have been prepared, probably sufficient to treat 3,500 infants, as compared with 58 liters of extract prepared in 1914. Slightly less than one half of the funds appropriated by Act No. 2376 has been expended.

MAINTENANCE OF STAFF

Continued agitation with regard to the Bureau of Science has made it impossible to hold out inducements to new or assurances to old employees, has influenced some of the best of our oldest and most experienced men to resign when other opportunities for employment offered, and has made it difficult to secure new employees of ability. Unless a fixed policy is adopted with respect to the Bureau of Science, it will be impossible to maintain a service with its former efficiency.

REPORT OF ASSEMBLY COMMITTEE

In accordance with Assembly Resolution No. 108, dated November 9, 1915, a Special Committee of five members was appointed by the Speaker of the Assembly to investigate and make recommendations before January 1, 1916, concerning "the utility and desirability of uniting the branches of the Government which have to do with agriculture in order to avoid unnecessary duplication of work, to abolish unnecessary expenditures and to coördinate and increase the efficiency of the work." Extracts from the report of the committee thus appointed follow:

The members of the Committee have made every possible investigation tending to cast any light on the business intrusted to them. They have visited all the offices in any way affected by the Resolution and have conferred with all the chiefs of the respective bureaus. They have cited witnesses, heard their declarations, and obliged them to state their opinions, having held public sessions on the 19th and 23d of November and the 4th of December of this year. Various documents referring to the matter have been consulted in the files of the Executive Secretary's office. The Committee even made several trips, one to Los Baños, where the College of Agriculture is, one to Limay, Bataan, where there is a Forest Station, and finally to Lamao, in the same province, where there is an Agricultural Experiment Station.

We here wish to express our satisfaction with the cordial and valuable coöperation granted us by every one of the bureaus interested in the matter and to put on record our appreciation of their aid.

It is the opinion of your committee that much of the confusion and divergence of opinion which has existed in the past in reference to the general subject under consideration here have been due to the lack of a clear and definite understanding of the various forms of agricultural activity which should be carried on by the Government and of just where

and what the limits of the jurisdiction of each of the subordinate bureaus should be * * *.

BUREAU OF SCIENCE

In no other division of its labors has your committee proceeded with greater caution and we believe with greater thoroughness than in that which refers to the Bureau of Science. This was necessary both because of the highly scientific work in which the Bureau is engaged and also because of the various criticisms which have been made for years past. Your committee confesses that at the time of beginning the investigation of the Bureau of Science we were rather prejudiced against it and were inclined to think that it was an expensive and unnecessary governmental activity, but the deeper we went into the matter, the more certain it seemed to us that both in its theoretical as well as in its practical work the Bureau of Science has rendered abundant return for the money which it has cost. Its work is far more practical and is of much greater and more immediate material value than is popularly supposed.

In theory, as well as practically, the organization of such an institution as the Bureau of Science is excellent, involving as it does the centralization and concentration of all governmental and scientific investigations, thereby, on the one hand, assuring better results as to efficiency and economy and, on the other, preventing the so often criticized duplication of almost identical work by different organizations. The amount of investigation work carried on in the Philippine Government is not large as compared with that of many other countries in the world, but it is very varied. Thus the Bureau of Health must perform or have performed laboratory work in chemical, botanical, entomological, microscopical, bacteriological, and pathological branches. The Philippine General Hospital needs similar facilities. The professors and advanced students of the University demand the same facilities for carrying on important work. The Bureau of Agriculture needs similar laboratory facilities for its work, and the Bureau of Forestry needs a certain amount of research work in relation to forestry. The Bureau of Public Works must have a large number of chemical analyses made to test the materials of construction used in architecture and engineering, and similar analyses are needed by the Bureau of Supply, the Bureau of Customs, and the Bureau of Internal Revenue.

Adequate laboratory equipment is exceedingly expensive, and the amount of work needed by few, if any, of the bureaus above mentioned is sufficient to justify the equipment and maintenance of an independent laboratory with the necessary subordinate personnel, etc. In the aggregate, however, the work of such character performed by *all* bureaus of the Government is amply sufficient to justify the expenditures required for maintaining the Bureau of Science, which was formerly known as "The Bureau of Government Laboratories." Here all of the investigative work requiring laboratory facilities can be performed adequately and comparatively inexpensively for all branches of the Government.

Nor is this the only reason that can be adduced in favor of maintaining the Bureau of Science. Not only in the matter of equipment is centralization necessary but it is also necessary in order to avoid duplication and in order to utilize to the fullest extent the results of all investigation work. In a country like the Philippines, which in a scientific sense is a new field, there must also be carried on a large amount of investigative work which at first seems to have no bearing or immediate relation to the

necessities or present work of any other bureau, but is nevertheless necessary to serve as a basis for work which later will be obviously directly applicable. The details of any subject cannot be considered intelligently without first knowing its general outlines. Thus, for example, before the Bureau of Health can adequately study the transmission of diseases due to insects or vermin, it is necessary that there be performed a large amount of work on Philippine entomology in general. Similarly, before the Bureau of Agriculture can adequately investigate such a disease as that of coffee blight, it is necessary that a considerable amount of work on the fungi of the Philippines shall have been carried on. In the same way, in order to enable the Bureau of Forestry properly to identify the commercial timber trees of the Philippines, a ground work in Philippine botany is needed.

These considerations it seems to your Committee furnish the justification for much of the work which has been carried on by the Bureau of Science in past years and which has been characterized by the public in general as "impracticable." In the opinion of your Committee it is not "impracticable" and should not be considered so merely because it does not immediately and directly result in material value, but, on the other hand, it furnishes the fundamental basis for more obviously practical studies.

We believe that this rather long introduction is necessary for a full understanding of the recommendation which we are about to make.

1. We believe that the Bureau of Science should be intrusted with all laboratory equipment needed by any branch of the Insular Government, particularly by any branch located in Manila; and so far as possible, a similar plan should apply to the provinces. This is the best, in fact the only way, to avoid unnecessary and expensive duplication of equipment.

2. We believe that all scientific collections which are liable to be used by more than one bureau should be assigned to the Bureau of Science. We have already spoken of the undesirability of having the entomological collections of the Government housed at the College of Agriculture near Los Baños, where they are inaccessible to other branches of the Government and to the public in general and where, as has been shown, only a small proportion of the collections are used by the students and where the collection, by distracting the interest and attention of the students and professors, interferes with their strictly agricultural studies. Your committee believes that it should be returned and housed in its original location in the Bureau of Science where it will be available for use by the Bureau of Agriculture, the various branches of the University in Manila, the Bureau of Education, the Bureau of Forestry, and other branches of the Government, as well as by the public in general and by visiting scientists.

Similar considerations hold in reference to the botanical collection known as the Philippine herbarium, which for several years has been housed in the Bureau of Science, where we believe it should remain. To transfer this Government herbarium to any other institution outside of Manila would inevitably reduce its value to a mere fraction of that which it now possesses. The herbarium was founded and now exists not for the use of any one department of the Philippine Government nor even for the Government alone. It has become one of the greatest herbaria of the Orient. It contains tens of thousands of specimens which are of no special interest or value to the instructors and students in the College of Agriculture or to the members of any one bureau, but which are of constant and very great value to other departments of the Government (Bureaus of Education, Forestry, Internal Revenue, Customs, etc.), to the students in

the various colleges in the University of the Philippines (particularly the Colleges of Liberal Arts, Pharmacy, and Medicine), to private botanical collectors, and to the students and visiting scientists from foreign countries.

The centralization of scientific research in a single bureau such as in the Bureau of Science also greatly increases the ability of the Government to meet a sudden emergency such as, for example, that made necessary by a sudden outbreak of bubonic plague or of cholera when thousands of rats and a similar number of specimens of fæces must be examined accurately and quickly. It is impossible, of course, to predict when such an outbreak will occur, and therefore there must be kept, somewhere in the Government service, a staff of men capable of responding to an immediate call. By having such men held as members of the Bureau of Science not only do they form a more mobile and efficient corps than would be possible if they were split up among various bureaus, but their spare time between emergency calls, when they would otherwise be more or less idle, can be used to full advantage by the Government in having them carry on the various scientific investigations such as those referred to above.

It is also desirable to take into consideration the mutual stimulus and enthusiasm which result by bringing all or most scientists together in one place for the performance of their various work. By having all such men in one institution there is close coöperation between those representing the different but allied sciences, and a great deal of work is accomplished which no one man could work out alone and which would not be attempted were the individuals isolated * * *.

TRANSLATIONS

The Bureau of Science has no official translator, and several of the scientific men have worked faithfully in translating into Spanish and Tagalog some of the results of the work of the Bureau of Science which are of great interest to the public. The following list gives a general idea of the work accomplished along this line:

Notas sobre el beriberi (Williams). [Read before the Colegio Medico-Farmaceutico.]
La mejora de la industria del curtido de las Islas Filipinas. [Press Bulletin No. 41.]
Notas sobre el suministro de aguas (Heise). [Read before the Colegio Medico-Farmaceutico.]
Notas de interes para los hacenderos de azucar (Thurlow). [Press Bulletin No. 35.]
La industria del azucar en Negros (Thurlow). [Leaflet.]
La conserva del pescado en los paises tropicales (Seale). [Translated for the Philippine Net and Braid Manufacturing Co. Inc., of Manila.]

BIOLOGICAL LABORATORY

Personnel.—The medical personnel of the Bureau of Science is in a seriously depleted condition. Dr. M. A. Barber, who succeeded Dr. E. L. Walker as chief of the biological laboratory, went on leave in January, 1915, and resigned to accept a position

with the Rockefeller International Health Commission, and Dr. John A. Johnston has been acting in his stead. During the absence of the Director of the Bureau, Doctor Johnston was Acting Director. Since 1911 there have been three resignations from the position of chief bacteriologist, the men leaving to accept what to them were more attractive positions. The personnel has been more and more reduced on account of resignations, on account of a reduction of the number and salaries of positions by the legislature, and on account of inability to fill vacancies promptly. Dr. J. D. Jungmann, in charge of the clinical laboratory at the Philippine General Hospital, was transferred to the Bureau of Health on January 1, 1915. Doctor Johnston went on leave in October, 1915, and since that time the responsibility for the work has been divided. Dr. Otto Schöbl went on leave in March and has been serving temporarily with the State Quarantine Service in New York, assisting in the detection of cholera carriers. He will sail on February 5, 1916, from San Francisco on the return trip to Manila. Dr. Charles E. Gabel was appointed assistant bacteriologist, and arrived here from the United States on June 19. Dr. H. W. Wade, formerly a bacteriologist of Charity Hospital, New Orleans, has been appointed bacteriologist and pathologist and will sail from San Francisco on January 1, 1916.

Routine.—In coöperation with the Philippine Health Service, by locating many of the sources of infectious diseases, we have been able to avoid serious epidemics, such as those of plague, cholera, typhoid, and dysentery, which have occurred in former years. Since the first two months of the year there has not been an unusual number of fæces examinations for cholera. It is impossible to say how the necessary bacteriological laboratory work could have been cared for during the past year, if there had been a serious epidemic. With so many resignations the Bureau would have been unable to perform the routine examinations requested by the Bureau of Health except for the faithful performance of much overtime work by the junior members of the staff. In former years the Bureau of Science had sufficient personnel properly to combat any epidemic that might arise, and when epidemics were under control the biological employees were able to investigate the diseases of the Archipelago. As a result of such investigations, diseases that were formerly formidable are now controlled with little difficulty. Notably among such is entamœbic dysentery. Also, through the diagnostic analyses of this institution it was discovered that the spread of cholera frequently and generally was through carriers rather than by

contact with those who succumbed to the disease. During the past year numerous specimens were examined in a systematic effort to eliminate "carriers" from among persons engaged in handling foods. Each sample was examined for the presence of cholera and typhoid organisms as well as for entamœbæ and other intestinal parasites. Among the latter were found chiefly *Ascaris, Trichuris, Oxyuris, Strongyloides*, and hookworm. By such methods people who consciously or unconsciously harbored infectious material were made aware of its presence, and the public was protected from contamination. These procedures help to prevent epidemics and are reducing the large percentages of cases of intestinal parasitism. In October the examinations showed many throat swabs positive for diphtheria. The number of diphtheria carriers increased, as is usually the case before an outbreak of an epidemic. However, by stringent sanitary measures, which necessitated the examination of a large number of contacts and a great deal of overtime work on the part of employees, the outbreak was aborted, and no serious epidemic resulted. Besides the various routine tests for pathogenic organisms, other examinations were made. Mineral and other waters and milk were examined bacteriologically. The United States Hygienic Laboratory phenol coefficient test was applied to a number of disinfectants. The diagnostic work imposed upon the Bureau of Science by law and carried on during the year and made during the fiscal year 1914 is given in parallel columns in the following table:

Nature of examination.	Calendar year.	
	1914	1915
Waters	2,118	2,985
Gonococci	16,383	15,832
Widal test	599	5,168
Blood	6,398	27
Blood cultures	392	
Fæces	[a] 126,022	50,021
Leprosy	1,142	569
Plague	64	1
Rats for plague	[a] 113,337	79,298
Sputum	2,095	85
Urine	4,275	2
Rabies	35	21
Wassermann test	1,288	633
Histological examinations	181	473
Necropsy	412	117
Miscellaneous	1,649	9,989

[a] Suddenly increased by more than 50 per cent due to examination during an epidemic.

Sera and vaccines.—There has been little change in the production of these biological products. In 1911 there were three technical employees engaged in the preparation of sera and vaccines, whereas at the present time only the head employee of these remains. Some of the work accomplished in the past five years is shown by the following table:

Sera and vaccines prepared at the Bureau of Science.

	1911	1912	1913	1914	1915
Vaccine virus ......doses	3,451,436	2,148,186	2,237,672	1,295,625	1,875,901
Plague prophylactic cc	......	......	3,660	......	......
Mallein ......doses	473	532	512	352	589
Diphtheria antitoxin ......units	234,000	639,000	983,000	169,500	50,000
Tetanus antitoxin ......do	610,250	1,821,700	1,406,500	1,756,000	7,482,000
Antiplague serum cc	......	60	9,540	7,860	3,600
Antidysentery serum ......do	780	1,950	2,280	830	2,200
Antityphoid serum ......do	......	52	3,000	960	2,910
Tuberculin:					
Human ......do	570	575	26	150	492
Bovine ......do	191	224	50	33	......
Antistaphylococcus prophylactic, aureus and albus ......do	168	......	622	......	......
Normal horse serum ......do	11,200	25,160	20,580	16,110	27,590
Typhoid vaccine ......do	......	......	1,760	1,876	1,911
Antigonococcus vaccine ......do	......	370	1,146	......	......
Staphylococcus albus vaccine ......do	......	......	85	124	570
"B" coli vaccine ......ampules	......	......	135	5	......
"A" serum for exophthalmic goiter cc	35	......	......	......	......
"B" serum for exophthalmic goiter ......do	200	......	......	......	......
Streptococcus vaccine ......ampules	......	......	82	19	......
Antistreptococcus serum cc	......	......	2,070	30	1,830
Rabies vaccine ......doses	404	(a)	(a)	(a)	(a)
Tuberculin, bovine ......do	......	......	......	200	......
Gonococcus vaccine ......ampules	......	......	......	814	2,350
Bacterial vaccine ......do	......	......	......	90	19
Antimeningococcic serum cc	......	......	......	2,970	4,920
Antisheep hæmolytic amboceptor ......units	......	......	......	......	7,500

[a] The Pasteur treatment for rabies is now practically entirely administered by the Bureau of Science, although we continue to send out rabies vaccine when it is requested. Thirty-four patients were treated at the Bureau of Science in 1912, 36 in 1913, 35 in 1914, and 112 from January 1 to December 31, 1915.

This table shows that as much work is accomplished now as formerly, and in some cases there is an increased demand for sera and vaccines. In order to accomplish so much, the employee has been compelled daily to work many hours overtime as well as on holidays and Sundays. Great difficulty was experienced in securing suitable horses for the production of diphtheria anti-

toxin, and since April the demand for the antitoxin has exceeded the supply. A number of inquiries relative to the Pasteur treatment were received, and an opportunity was given to correct several misunderstandings as to the nature of this treatment and its application, which may account for the increase in the number of cases treated during the year.

INVESTIGATION

The articles published in the Philippine Journal of Science are given on pages 45, 46. Other investigations have been made, but the reports are not yet published.

Cholera.—The investigation as to the mutability of the cholera vibrio has been continued by Doctor Schöbl at the New York Quarantine Station.

Malaria.—Doctor Barber and his assistants completed their study of malaria in the Philippines and conducted a survey as to the distribution of the commoner forms of anopheline mosquitoes and the distribution of malaria.

Leprosy.—The studies in the etiology and bacteriology of leprosy are still being continued. Experimental work with animals in two instances has given very promising results. The investigations of chaulmoogra oil with a view to obtaining an active principle or an allied body, begun last year in coöperation with the organic chemists, are being continued, and treatment with the various fractions and products that have been obtained from the crude oil are now being made available to patients at the Culion Leper Colony.

Plague.—The routine work of the examination of rats has been continued. But one case of rat plague has been discovered.

Pathology.—An important monograph on the pathology of plague was completed during the year.

Sanitary Health Commissions.—For many years it has been the policy in the conduct of the biological work of the Bureau of Science to send men to various provinces outside of Manila, when opportunity presented itself, for the study of disease. In 1909 an extensive expedition for the purpose of carrying on a complete medical survey in a typical provincial town was organized by the Bureau of Science and the Bureau of Health of the Philippine Government. The information obtained was thought to be typical of a Filipino town under normal conditions, and the results have been very helpful in the work of sanitation. During recent years, owing to the increases in routine work and the reduction of staff, less of this work has been done, whereas for the best interest of the Filipino people the work should have been ex-

tended. The health of the community can be greatly improved by a study of the geology and the bacteriology and chemistry of the water supply, the fruits and vegetables and other food of the people from a physiological standpoint, the insect pests, the general sanitary conditions, the animal parasites of the intestines, the examination of the blood with reference to fever parasites, as well as an examination to determine the prevalence of tuberculosis, beriberi, venereal and skin diseases, etc. The present Director of Health realizes the benefit to his work of an intense sanitary survey in the provinces. Sanitary commissions have been formed, and the work is being carried on in two towns. The Bureau of Science is coöperating and is responsible for the bacteriological work. It is proposed to extend the work as rapidly as funds will permit.

General.—Owing to resignations and the large number of routine tests, other lines of work have been handicapped. When the demand for examinations necessary to suppress infectious organisms is decreased, other sanitary measures should receive more attention. The bacteriological examination of foods and drugs will result in cleaner and more wholesome products. We have been able to establish definite chemical standards for our foods and drugs, and so in time we should also have definite bacteriological standards. Due to lack of personnel we are unable to test many substances that are examined bacteriologically in the United States. For example, the following indicates the nature and number of some such samples examined in the Denver Bacteriological Laboratory of the United States Department of Agriculture as given in the American Food Journal (1915), **5**, September: Air, 5; butter, 45; butter-milk, 12; butter starter, lactic acid cultures, 7; candy, 71; cheese, 4; cornmeal, 60; cream, 253; figs, 4; gelatin, 82; starch, 5; wash water from hands of persons handling food, 6; wash water from tanks in creameries and bottling houses, 8.

SECTION OF BOTANY

Personnel.—The work has been very greatly restricted during the past year by depletion of the force. The chief botanist, Mr. E. D. Merrill, was away on leave of absence from April 4, 1915, until the close of the year, leaving but a single technical employee, Dr. W. H. Brown, in the section. During the part of the year that Mr. Merrill was in Manila, he continued as heretofore to render service in the University as associate professor of botany and head of the department. He also gave a special course of ten lectures on medical botany in the post-graduate medical

course. At the opening of the school year 1915-16, Doctor Brown was detailed to the University to take over the classes formerly under the direction of Mr. Merrill, and this ultimately led to Doctor Brown's transfer to the University in July, under an arrangement by which he devoted one day per week to the Bureau of Science. The position of mycologist was filled by the appointment of Dr. Harry S. Yates, who reported for duty in August, 1915.

Exploration.—Comparatively little field work has been done during the past year, owing to the depleted force. The work has been done chiefly by Mr. Ramos, with the exception of one important collection made in Laguna Province, Luzon, by Mr. McGregor. Collections have been made by members of the Bureau staff in Batangas, Cavite, Cagayan, Bataan, Rizal, Laguna, and Sorsogon Provinces.

Mycology.—Fungi are inconspicuous plants, some species of which cause the most troublesome plant diseases, such as some of those of coffee, coconut, and tobacco. The study of fungi in the Bureau of Science consists of two lines, namely, systematic mycology and plant pathology. The first is concerned with the scientific name of the species and whether or not the same species is found in other countries. The second is the study of the effect of fungi upon the higher plants, especially cultivated ones, and the study thus becomes economic. Both are intimately connected, and a large amount of purely systematic work must be done before definite progress can be made in the more economic aspects of the question. That is, the mycologist must first know the name and systematic position of the organism he is considering, otherwise the economic work in other countries is not available to him. The effect of fungi upon animals is a large field that so far has been little touched upon in the Philippines.

The Bureau of Science has been carrying on systematic mycology for a number of years, and the herbarium contains a fairly complete representation of the named fungi known to occur in the Philippines, totaling several thousand specimens. The nucleus of an extra-Philippine collection has also been established by an exchange of duplicate material. In view of the fact that no large herbaria exist in this part of the world, this foreign material is essential for purposes of comparison; without it, it would be necessary to send a great part of our material to European specialists for identification. Hardly more than a beginning has been made in the study of the fungi of the Philippines. In spite of the relatively large amount of work already accomplished, the number of new species in all collec-

tions brought from the field is surprisingly large, and this is true even of collections made in regions supposed to be botanically well known. In developing the work in mycology, it is planned to continue the field work to build up the herbarium as rapidly as possible both by collection and by exchange.

In plant pathology very little has been done in the Philippines, although this subject is one of very great economic importance. It will become increasingly important with the development of agriculture in the Archipelago. It is probable that there now exist in the Archipelago many of the diseases of tropical plants known to be caused by specific fungi, and very likely there are special diseases caused by endemic, parasitic organisms. However, at the present time very few plant diseases are definitely known to occur in the Philippines, and in no single case has any careful and critical local investigation been made. We have one very destructive disease of the coffee; a few apparently not especially harmful diseases of the coconut, sugar cane, corn, rice, and tobacco; and a recently discovered, and apparently very serious, disease of citrus fruits. While some very serious plant diseases now occur in the Philippines, it seems to be well established that very many serious pests in other countries have never reached our Archipelago. To guard against the possible inadvertent introduction of destructive fungi from other countries, all imported stock should be carefully inspected by a competent, trained mycologist. Likewise all stock shipped out of the Philippines should be so inspected. The plans for the coming year include a general survey of the species of fungi known to produce disease in plants that are now known in the Philippines and a careful examination of cultivated plants whenever possible to detect as many of the pathogenic fungi as possible. In those cases where species are known we can simply apply the methods of control and eradication already perfected by mycologists in other countries. It is planned to investigate intensively new forms, which are expected to appear in the course of this campaign, especially if they appear to cause serious disease. In the meantime reorganization of the mycological collection is being pushed as rapidly as possible, species and host indices prepared, and material already on hand is being placed in the hands of specialists for study. In coöperation with one of the chemists of the Bureau, work is being done on the effects of molds on stored copra, a subject which has received little consideration, yet apparently is one of great economic importance.

Physiology.—Work similar to the extended discussion of the Philippine dipterocarp forests, the chief local source of building

timbers, by W. H. Brown and D. M. Mathews, in the Philippine Journal of Science, Section A (1914), 9, Nos. 5 and 6, is to be continued in the near future on the pine forests of northern Luzon. Considerable progress has been made in a study of the water relations of certain plants, particular attention being given to the relative relations of absorption and evaporation under different conditions.

The field work on the distribution of plants on Mount Maquiling in relation to the environmental conditions has been completed. This work consisted in taking careful and continuous records of temperature, rainfall, humidity, wind, evaporation, and soil moisture in several different situations in a number of localities at various altitudes from the base to the summit of the mountain and relating these data to the rate of growth, size, number, and character of the trees or other plants found on the area. For comparative purposes similar work has been commenced on Mount Banahao. On the completion of this work many classes of vegetation can be directly correlated with climatic factors. Thus, by observing the natural vegetation of a given area, to a large degree, the nature of the climate and the agricultural use to which the region in question is adapted can be determined. The idea may be summed up in the determination of certain prevalent types of vegetation as the indicators of the value of the areas for agricultural purposes.

Herbarium.—During the absence of Mr. Merrill in the United States, current identifications of material for the Bureau of Forestry were made by Mr. Fénix, who was also responsible for the general care and arrangement of all original and duplicate material received. The work of Mr. Fénix in this difficult position has been excellent, and he has correctly made a high percentage of identifications. The European war has cut off many exchanges. In continuation of the exchanges and relations with specialists previously arranged, 9,130 duplicate botanical specimens have been distributed. Of these about 7,000 have been distributed in exchange, about 1,500 have been sent to specialists for study and report, and 648 have been identified, mounted, and turned over to the Bureau of Forestry for distribution to the various provincial forestry stations. Mounted sheets loaned to specialists for study number 439. Many duplicates from the collections accumulated during the past year, and several undistributed sets of older collections cannot be shipped now because of war conditions.

Philippine accessions.—Collections made by employees of the Bureau of Forestry were approximately the same in quantity

as in the preceding year. Under the circumstances the increase in the herbarium has been satisfactory, although especially on account of the lack of personnel the number of Philippine plants added is less than for several past years and is 4,857. These have been received by collection, by gift, for identification, and by transmission from other departments of the Government. The important collections of Philippine material are:

Collections of employees of the Bureau of Science	2,348
Collections of employees of the Bureau of Forestry	1,551
Miscellaneous collections of Messrs. Wester, Octubre, Sandkuhl, Topping, Baker, Eskridge, Gates, and Vanoverbergh, and of Mrs. Clemens	958

Foreign accessions.—The extra-Philippine material received, consisting of 6,356 specimens from all sources, has been poisoned and mounted and will be distributed into the herbarium. The large Formosan collection, purchased from Abbé Faurie, is of especial value for purposes of comparison. Likewise a valuable lot of material, very rich in cotypes, was received from the Royal Botanic Garden in Calcutta.

Foreign accessions during the past year were as follows:

P. Magnus, miscellaneous fungi in exchange	95
Mrs. M. S. Clemens, Chinese plants for identification	2,404
P. Nelson, Guam plants for identification	43
Native collector, Sarawak, Bornean plants for identification	216
Dr. Fred Baker, Malayan ferns for identification	22
Dr. J. H. Maiden, Sydney Botanical Garden, Australian plants in exchange	99
Rev. C. King, New Guinea plants for identification	78
Zenker, Kamerun plants, T. O. Weigel, exchange	98
A. F. G. Kerr, Siamese plants in exchange	209
I. H. Burkill, Singapore, Malayan plants in exchange	226
R. Kanehira, Polynesian plants for identification	91
T. Kawakami, Formosan plants in exchange	145
Calcutta Botanic Garden, Malay Peninsula plants in exchange	354
U. S. Department of Agriculture, Meyer's Chinese plants in exchange	139
Abbé U. Faurie, Formosan plants, purchased	2,090
Dr. Fred Baker, Formosan plants, presented	47

Important extra-Philippine collections on hand urgently in need of study are the Robinson Amboina collection of approximately 1,200 numbers; about 3,000 numbers from Borneo, secured through the courtesy of Mr. J. C. Moulton, of the Sarawak Museum; and small collections from Polynesia and New Guinea.

Arrangements have been made to have the extensive Chinese collections made by Mrs. Clemens, totaling nearly 4,000 numbers, studied and reported on by European specialists. Preliminary work has been done on the Robinson Amboina collection, and I hope the work can be completed during the present year.

Total accessions.—The specimens added from all sources to date increase the grand total of the herbarium to 160,354 mounted specimens, of which 92,357 are Philippine and 67,997 are extra-Philippine. An especially valuable lot of material from Mount Kinabalu, Borneo, was received from Mrs. Clemens just at the end of the year; it is not included in the totals, as there was no time to prepare it.

Publications.—A list of the papers that have been published in Section C, Botany, of the Philippine Journal of Science is given on page 47.

SECTION OF ICHTHYOLOGY

Fish culture carried on by the Bureau of Science has progressed steadily. The black bass, *Mycropterus salmoides*, brought originally from the United States in 1907, have increased in a satisfactory manner both in Baguio Lake and in the spawning pond built near the Bureau of Science. Lake Lanao was stocked last year with fry from Baguio, and in October bass fry from the Bureau of Science pond were planted in a seldom-frequented portion of Laguna de Bay where it is believed they will thrive. The stocking of these lakes with black bass will mean a considerable increase of the available food supply of the respective communities and will be a factor in keeping them free from mosquitoes. Other lakes will be stocked from time to time. The Bureau of Science also has distributed many mosquito fish to those who have applied. There is still an ample stock ready for distribution. The economic fishery industries of the Islands have been stimulated in many ways, and instruction regarding the construction of fish ponds and other information have been given. The fish expert was absent on leave in the United States from May 16 to December 3, 1915, and consequently somewhat less work has been accomplished than in previous years. The services of Mr. A. L. Day, of the University of the Philippines, were secured during the period for carrying on the routine work.

The fish expert was detailed on December 18, 1915, further to study Philippine pearl fisheries and to coöperate with the Governor of the Department of Mindanao and Sulu in proposing an act regulating the fishing for shells of marine mollusks in waters of the Philippine Islands. An act regulating the

sponge fisheries in the Philippine Islands was prepared. Both of these proposed acts have been or soon will be presented to the legislature and if passed will be satisfactory to the fishing concerns and fishermen themselves. They will also be comparatively easy to enforce.

SECTION OF ORNITHOLOGY AND TAXIDERMY

The efforts of the section of ornithology and taxidermy now are mainly devoted to economic ornithology; that is, the study of the feeding habits of birds for the purpose of determining the beneficial and the injurious species. The most important part of the study of food habits includes the field work of collecting specimens and the subsequent careful examination of the stomach contents. The largest single collection was made in Paete, Laguna, especially selected because it is in the center of a large rice-growing area. Over 500 birds' stomachs have been examined, and the results have been recorded on cards. This number of specimens scattered unevenly among several hundred species does not result in many specimens of any one species; consequently there are not enough records for any one species to warrant generalizations as to its food. However, enough work has been done to show its importance and to indicate that unexpected interrelations of organisms will be discovered. A few examples are here given to show the kind of results that may be expected from the intensified and completed study.

One of the most abundant birds about fresh water swamps and grassy borders of lakes is the moorhen, *Gallinula chloropus* Linnæus. The stomach of a moorhen killed at Paete, Laguna, on July 3, 1915, contained 19 larvæ of a tabanid fly that may very easily be *Tabanus striatus* Fabricius, the most prevalent horsefly of the Philippines. Other specimens of the moorhen also had eaten tabanid larvæ. Mitzmain found that this species plays "a rôle in the transmission of surra." [See Philippine Journal of Science, Section B (1913), **8**, 223–229.] Therefore it seems probable that the moorhen is an important agent in preventing surra from becoming an uncontrolable epidemic.

The only species of grebe (hell-diver or dabchick) inhabiting the Philippine Islands is *Tachybaptus philippensis* (Bonnaterre). Examination of five stomachs of the Philippine grebe showed that two had eaten small shrimps of commercial value; two had eaten specimens of a water bug (Belastomidæ) that may be injurious to fish fry; and one had eaten a beetle, *Cosmopolitus sordidus* Germar, that is injurious to banana-plant roots. This is suf-

ficient to show the nature of the field for investigation offered in the study of the food of this species of bird. The grebe may be injurious to the shrimp fishermen, but on the other hand it is possible that the water bug which it eats is injurious to the young fishes. Therefore further study is necessary before this bird can be classified as injurious or beneficial.

These two illustrations show the importance of including all species of birds in the food investigation. Birds that are least expected to be of economic importance may prove to be highly beneficial or injurious.

In connection with the food investigation a blank has been prepared asking for information on the food habits of birds. This blank will be sent to members of the Agricultural Congress for the purpose of obtaining data as to what birds are injurious or beneficial to the farmer in various provinces. A circular letter has been printed to be sent with the blanks. The president of the Congress has approved this plan and promised the coöperation of the members.

Bureau of Science press bulletin No. 32, which was distributed September 23, 1914, has been revised and illustrated with small cuts of some Philippine birds. This is issued as a 14-page pamphlet with the title Birds in their Economic Relation to Man. The pamphlet is intended for distribution in the Philippine Islands in order to call attention to the very practical value of birds as protectors of forests, crops, etc.

Miscellaneous work was carried on as follows: Commercial taxidermic work such as mounting specimens of birds and fruit bats; the sale of scientific specimens to collectors in the United States; the dispatch of six cases of mounted birds for exhibition at the Northern Luzon Fair at Baguio; 500 numbers of plant specimens collected for the section of botany and for identification of food of birds; a series of rat specimens sent to the United States National Museum for identification in order to determine the host of the flea responsible for the transmission of plague; birds sent to the United States National Museum for identification; etc. Specimens have been gradually added to the collection of birds, and new or rare species have been reported.

SECTION OF ENTOMOLOGY

There was no appropriation for an entomologist; consequently none has been on duty during the year, and all the work accomplished by this section has been done under the supervision of the ornithologist. The regular stock of silkworms has been carried through the year. Those who have applied for silkworms

have been informed that if they have a sufficient number of mulberry trees under cultivation to provide food for the silkworms, the Bureau of Science will be glad to furnish eggs with which to start. Eggs and cocoons have been supplied to those who were prepared to raise them, and instructions in the care of the worms have been given to several persons who wished to establish silk farms.

The production of silk is well suited to the people and the conditions in the Philippine Islands. The many years' work at the Bureau of Science has fully demonstrated that silk can be produced, but it is not to be expected that under present conditions the desired growth of the industry will result. The necessity for demonstrators to carry on this work is pointed out on page 54.

Efforts are being made again to introduce the eri silkworm, which feeds on the leaves of the castor plant. The cloth woven from the silk of this silkworm is believed to be of superior quality. However, it is to be remembered that the silk of the ordinary silkworm is a well-known product with a market value, while eri silk is little more than a curiosity, which even if produced in quantity would require time and money to introduce to the world.

Dr. R. P. Cowles, of the University of the Philippines, has taken advantage of the facilities at the Bureau of Science in order to carry on some experiments in breeding silkworms. There is a large amount of practical work as to the best races of silkworms that should be introduced and crossed with our own in order to retain the present stock in vigor and free from danger of disease.

CHEMICAL LABORATORY

Personnel.—See division of general, inorganic, and physical chemistry and division of organic chemistry.

INVESTIGATION

The effect of the European war has been greatly to increase the burden of work on the chemical laboratory of the Bureau of Science. Many supplies have been cut off from the Philippines by the inability of certain countries to keep up their manufacturing industries and by the tremendously increased and continually increasing freight rates. In connection with its regular routine work the chemical laboratory has been called upon to solve problems that required much research ability. For example, new bleaching methods have been made possible to several enterprises. Many industries have been improved and adapted to war condi-

tions. In addition to the regular requested examinations the chemists carry on as many investigations of industrial subjects as time will permit. I have frequently pointed out the importance of determining the most efficient methods for treating certain commodities, discovering uses for hitherto unknown, and new uses for already useful, materials, etc. The following are some of the investigations that have contributed and are contributing to these ends:

The properties and some of the uses of oils produced from lumbang, kapoc, cashew, castor bean, tree cotton seed, physic nut, pili, calumpang, and cato have been determined. The drying qualities of the lumbang oils have been examined. Further uses for some of these oils and their properties when hardened by reduction with hydrogen are now being investigated. Chaulmoogra oil and its administration in the treatment of leprosy is being coöperatively studied by the organic chemists and the biological experts of the Bureau of Science. In attempts to treat leprosy, great variation was found in the efficiency of various purchases of chaulmoogra oil and in the degree of tolerance that patients exhibited toward different shipments. Frequently a crude oil appeared to have greater curative properties than a pure oil. Commercial chaulmoogra oil is not obtained from a single species of tree, but from representatives of several closely allied genera of the Flacourtiaceæ. In view of these facts I thought there might be an active principle in chaulmoogra oil or that one member of this family might be wholly responsible for the curative properties and assigned men to the experimental work. It is interesting to note that the Philippine Islands possess several representatives of the Flacourtiaceæ: for example, *Pangium edule* Reinwardt and *Hydnocarpus alcalæ* C. de Candolle. In order to get accurate information and to solve some of the intricate questions involved, a few of the commercial oils have been studied, the study of the product of the former tree is now under way, and one of the latter will be undertaken as soon as material can be secured.

A complete survey of the medicinal plants of the Islands, together with an investigation of the chemical and physiological properties of their constituents, should be carried on by organic chemists and botanists in coöperation, and I hope to arrange for this work very soon.

Many oils available for the perfume industry have received attention. This work has resulted in the improvement of some of the old methods, making possible a better grade of ylang-ylang oil and the production of champaca, the finest perfume of the

Islands, and will be the basis for further industries in the Philippine Islands. One year ago Doctor Brill began work on gardenia, but owing to the lack of material it was discontinued. It is expected that sufficient flowers will be available this year to carry on the work. At present all perfumes sold as gardenia are artificially prepared, and there may be an excellent opportunity for the cultivation of the flowers in these Islands. There are many other flowers that are available for cultivation for perfumery in the Archipelago. These will receive study by the Bureau whenever quantities large enough to justify an investigation can be obtained.

Beriberi has been extensively studied by the Bureau of Science in the past, and many contributions with regard to the etiology of this disease have been published in the Philippine Journal of Science. Active study of this disease is not now in progress owing to lack of men. However, quantities of tiqui-tiqui extract for free distribution through the Bureau of Health under Act No. 2376 for the alleviation of infantile beriberi are now being prepared, as pointed out on page 10.

An article on papain shows conclusively that gum made in the Philippines is equal, if not superior, both regarding color and activity, to any now on the world's market. It is a good commercial proposition, provided a limited market is not flooded.

As material for paper becomes scarcer and more difficult to procure, it is increasingly apparent that the Philippine Islands are to play a larger part in furnishing a supply of the raw material. The Bureau of Science has investigated the suitability of the waste from abacá, or Manila hemp, cogon grass, and various other substances for paper pulp. Investigations by the Bureau have demonstrated that bamboo can be made into a high-grade pulp and that it will help to overcome the scarcity of the raw material for paper. So much interest has been shown that sales of the number of the Philippine Journal of Science containing information on this subject have exhausted the stock. A reprint of the article on Philippine fibers and fibrous substances and their suitability for paper making with regard to bamboo pulp has been made.

The Bureau of Science will very soon publish a preliminary article on the destructive distillation of waste woods of various kinds and the products obtained as a result of this distillation. This investigation should assure the utilization of the waste wood of the Islands. The resins and resinous woods have been investigated, and it has been shown that these are very similar to those from the same types of trees in the United States and

Europe. The economic possibilities of the mangrove swamps of the Philippines have been studied by the Bureau of Science and the results published. It was shown that there are areas of workable swamps yielding high-grade tanning materials capable of producing yearly a minimum of 1,500 metric tons of extract. Some of the waste wood could be used for piles. This new work provides for the utilization of the remainder of the waste wood and should insure the exploitation of the mangrove swamps.

The many unique and characteristic foodstuffs used by the Filipino population, as well as the citrus and other fruits, have received attention. An article on the various native vegetables used for food is almost ready for publication. The nutritive value of these products is now known and is available for studying dietary questions of great practical importance. All varieties of canned milks entering the Islands, as well as fresh cows', goats', and carabaos' milks, have been included in this study. As soon as personnel is available, I desire that a series of experiments be made for the study of nutrition as related to the Tropics. Such a study should throw light on the present confusion of ideas held with regard to the food necessary for sustenance in a tropical climate and should assist in controlling and reducing the high infant mortality. The importance of this work can be hardly overestimated.

The Philippine Islands export more copra than any other country. Many investigations have been and are being made and published by the Bureau of Science on coconut products, including the water relation of the coconut palm, the mold and bacterial causes of rancidity, the decrease in the oil content of the nut on account of its unripe condition and the locality in which it is grown, methods of drying, insect pests and preventive measures, effect of feeding copra cake to cattle and hogs, and the deterioration of copra during transportation. Not only is there loss in the copra or oil, brought about by picking green nuts, but insufficiently dried copra deteriorates on account of the multiplication of bacteria and molds thereon, and the oil that is expressed therefrom is dark-colored. No radical changes should be made in the methods of drying copra until the best methods to be adopted have been established. The work on coconut products, now being carried on in the Bureau of Science, is directed toward improved modifications of existing methods of drying so as to produce a copra that shall be white, sufficiently dry, and proof against molds. Such a product will yield an oil suitable for edible purposes and will have a high market price. Work is also in progress on a commercial method for the

production of a good grade of oil from the uncured nuts, thus avoiding the intervening step of drying the coconut meat. Simply by burning coconut shells instead of husk, smoke and a consequent black product can be avoided. The use of husk as fuel should be avoided for the further reason that the husk fiber is much more valuable for other purposes, such as the manufacture of brushes, doormats, etc. Many inquiries have been received from the United States and Hawaii relative to copra and copra-drying methods in the Philippines.

A great deal of work has been done on the sugar and alcohol industries of the Philippine Islands. In completed investigations it is shown that a greater profit is possible by making the sugar contained in palm juices into commercial sugar than by converting it into ordinary alcohol. Methods for handling the juices, so as to overcome the difficulties encountered in making sugar, have been determined and published. The manufacture of Philippine brandy may be more profitable than the manufacture of sugar. For a number of years the properties of coco and palm brandies have been under investigation. The effects of aging these brandies in wooden casks are being studied by analyzing the liquors at the end of each six-month period. The results, which will soon be ready for publication, indicate the changes taking place in these liquors under certain conditions and the best condition for bringing about beneficial ones.

Much molasses is being used for the production of alcohol. Considerable difficulty is being encountered by the manufacturers of alcohol from molasses in obtaining uniformly good results. The Bureau of Science should assist in the establishment of methods that will insure maximum yields of alcohol in all cases. There is no chemist available for this work.

The various methods of preparing sugar in the Islands have been studied, and it has been shown that in many cases a gain of sugar would result by allowing the cane to ripen, by using more nearly complete extraction, and by exercising greater care in handling the juices than is the common practice. The Bureau of Science Iloilo sugar laboratory, since it was established, has been eagerly used by both producers and dealers, who avail themselves of umpire polariscopic analyses in cases of dispute and as a basis for valuation. There has been opportunity in both Iloilo and Manila for a large amount of instruction in regard to the planting and harvesting of cane and the more perfect recovery of the sugar.

The Bureau of Science has carried on an investigation of tanning methods in the Philippine Islands. It consists of practical

work under conditions as they prevail in Philippine tanneries and shows how local methods may be greatly improved and that the product of the tanneries could be increased in quality and volume with very little increase in the capital invested. The Bureau of Science has produced leather free from the disagreeable odor characteristic of Philippine leather and equal in quality to the imported product. Furthermore we have successfully and satisfactorily tanned thick carabao hides, twice as thick as ordinary cattle hides, whereas by the Filipino processes carabao hides are tanned only with difficulty after they have been split. Well-prepared carabao leather is exceedingly beautiful and will find exceptional sale for the manufacture of trunks, suitcases, book bindings, etc. During the coming year we plan to extend the work to include practical demonstrations to tanners of the proper methods and to make a series of tests of several kinds of native barks, which are possibly adapted to the purpose. If the tanners will follow the process used by the Bureau of Science, the following yearly losses can be avoided:

	Pesos.
Due to incomplete tanning and partial putrefaction of the leather during the process, which constitutes a loss of 32 per cent of the weight of the finished product	576,000
Due to the decreased value of the inferior product as compared with imported leather	450,000
Due to waste and uneconomical tanning material	50,000
Total	1,076,000

The actual value of the leather tanned in the Philippine Islands is about ₱1,800,000 per annum, and the importation of leather and its manufactured products for the year 1914 amounted to ₱3,115,648. This shows the importance of the tanning industry in the Philippines and that due to its crude methods there is an annual loss of over ₱1,000,000.

A beginning has been made in an effort to safeguard the water supplies of the Philippine Islands. During the year the Bureau of Science has performed about 200 analyses of water from artesian wells, dug wells, reservoirs, springs, etc., which makes a total of about 2,000 water analyses on file in this Bureau. The work presented in a preliminary paper, consisting of 40 pages on the water supplies of the Philippine Islands by Cox, Heise, and Gana, has been continued. The Bureau of Science has made possible the differentiation between good and bad waters, not only with respect to potability, but also with regard to suitability for technical and industrial purposes. Work has been and

is being carried on to determine certain factors influencing the chlorination treatment of water as applied to Manila and other municipal supplies and on some of the analytical problems connected with such determination. A complete general study of the Manila city water supplies is about finished. In spite of this our knowledge of the quality and quantity of available Philippine water supplies is insufficient to enable us to reserve the most valuable springs. The time has come for more careful safe-guarding of the water supplies of the Philippine Islands. It seems to me that a duty the Government owes to future generations is to provide adequate water supplies now. A special fund for this investigation was recommended in my appropriation estimate, and I had hoped that the work might be pushed to completion. The laboratory methods of water analyses have been adapted and revised in an effort to secure the greatest amount of information from them. A field reconnaissance of water supplies has made fair progress. If we are able to perform the necessary and desired coöperative work with the sanitary commissions and investigate the municipal wells and medicinal and thermal springs, we shall be able to specify the normal constituents of waters and to develop standards of purity, both chemically and bacteriologically, for different localities. When this has been done, the Government can make reservations of suitable areas from the public domain surrounding springs of value.

The failure of the service pipes of the Baguio water-supply system led to an investigation that demonstrated the existence of corrosion due to the high acidity of the water. Methods for correcting the excess acidity were proposed and are soon to be put into use.

A very important investigation of Philippine clays to determine their suitability for the manufacture of paving brick, roofing tile, sewer pipe, etc., is under way. It is hoped that we shall be able to find material for making a light-weight roofing tile, which can be supported upon a light and cheap structure to take the place of nipa roofing. In this way destructive fires, which frequently occur in towns throughout the Philippine Islands, can be reduced in number and extent.

In 1913 the Bureau of Science tested and analyzed the different roofing materials submitted in the contest for a cheap substitute for nipa roofing. We were thoroughly convinced that by far the most satisfactory method for producing an inexpensive roofing would be the fire-proofing of nipa itself. The ordinary fire-proofing methods used gave promising results. This problem

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is of sufficient economic importance to justify investigation as soon as time and opportunity will permit. The literature relating to fire protection is being collected, and that on hand should enable us to develop a local standard promptly.

The correct classification of the climbing palms, which produce the commercial rattans of the Philippines, depends on a combination of characters that cannot be determined from the data and collection available. The many species in the Philippines belong to three genera. Some of these are small, the canes being 1 centimeter or less in diameter, while others have canes up to 5 centimeters or more in diameter. There is a great variation in the character of the rattans. The stripped material of some species is very tough, has great tensile strength, does not readily break in bending, and can be readily bleached. The rattans are notoriously difficult to classify from a botanical standpoint, because it is exceedingly difficult to prepare good herbarium specimens. In spite of this the Director of Forestry has at the suggestion of this Bureau issued a circular letter to all forest officers in charge of stations to send in proper material for this work. When the material arrives, further effort will be made to determine the differences that control the commercial product and to devise means by which well-bleached, or white, split rattan of standard commercial lengths can be supplied from Philippine materials.

Frequently maguey and other fibers are cheaper than abacá (Manila hemp) and are used as diluents in so-called Manila hemp rope and similar materials. Color tests to distinguish between abacá and other fibers have been developed. A satisfactory method of staining has been devised, which gives distinctive colors, such as golden yellow for abacá and pink for maguey.

The present method of extracting the fiber from the petiole of the buri palm, used for buntal hats, is slow and expensive. [See Bureau of Education Bulletin (1910), No. 33, pp. 33–41.] The Bureau of Science has undertaken to improve this method with the result that the quantity of fiber extracted in a given time by one individual is several times larger than the quantity obtained by the method at present in use. The results are being prepared for publication.

According to the Bureau of Customs 10,520,233 kilograms of galvanized iron, valued at ₱1,540,622 and used as a roofing and building material in the form of corrugated sheets, were imported during 1914. From 80 to 90 per cent of this is from the United States. Not all importations have given satisfactory

results, and the Bureau of Science is investigating the efficiency of various kinds of galvanized iron and the factors that affect their corrosion and expects to carry the investigation at least far enough to enable the Government to purchase all materials of construction according to specified requirements that will guarantee satisfactory service. (See Standardization, p. 9.) New methods of analysis and stripping of galvanized iron and tin plate have been developed, some of which may have extensive commercial application.

In addition to the work outlined on page 25 of my last report, extensive investigations of paint materials and various protective coatings for iron and steel and for metallic structures are being planned and are in progress, the Bureau of Public Works coöperating with both money and materials. The work will include a study of the effect of various additions, chiefly Philippine oils, to paint vehicles and an investigation of various types of rust-inhibitive coatings, with a view toward finding the best protection for metals under tropical conditions.

The publications of this laboratory are included under the heading Philippine Journal of Science, Section A. (See p. 45.)

The routine work of the laboratory has not changed materially and is of the same general character as described last year.

DIVISION OF GENERAL, INORGANIC, AND PHYSICAL CHEMISTRY

Personnel.—Mr. R. R. Williams, chief of the division, went on leave in February and resigned, effective April 16, 1915, to accept a position in the Bureau of Chemistry of the United States Department of Agriculture, Washington, D. C. Mr. T. Dar Juan was appointed chief analytical chemist on February 15, 1915. Mr. R. H. Aguilar was appointed on February 1, 1915. Mr. F. D. Reyes, who resigned on April 6, 1914, was reinstated on November 1, 1915. Owing to an insufficient personnel to care for all of the work, employees, including a graduate student of the University of the Philippines, were taken on as temporary assistants at various times. Besides the research work indicated above, the inorganic chemists have been busy with the analysis of a large number of samples. Of these over 8,000 have been received and reported upon during the year. For a period of several years before my appointment as Acting Director and Director of the Bureau of Science I was in direct charge of this work; therefore the capabilities of each employee are pretty accurately known to me. In view of this fact and the necessity for economy, I decided not to appoint a regular chief of division at present, but to keep in close personal touch with

the demands on the division and to place the work under three superintendents of sections who would report directly to me, as follows:

1. Section of analytical chemistry:
   Messrs. T. Dar Juan, A. S. Argüelles, F. D. Reyes, F. Peña, and G. Rantaso.
2. Section of weights, measures, water analysis, and physical chemistry:
   Messrs. G. W. Heise, V. Q. Gana, R. H. Aguilar, and E. Ignacio.
3. Section of physical and mechanical testing:
   Dr. J. C. Witt and Messrs. A. E. W. King and F. R. Ycasiano.

The work of the various sections, as specified in my memorandum order, is as follows:

Section of analytical chemistry:
Rocks, minerals, ores, slags, clays, limes; plasters, soils, fertilizers, etc.; iron and steel; metals and alloys; pigments and mixed paints, including vehicles; fuels, including calorific value; gas; and inorganic chemicals and other inorganic analyses, except fire assays.

Section of weights, measures, water analysis, and physical chemistry:
Waters, sewage, corrosion; weights and measures; and instruments and apparatus such as thermometers, pyrometers, microscopes, refractometers, and other physical and chemical apparatus.

Section of physical and mechanical testing:
Cements, aggregates; iron and steel; road materials; tars, asphalts, and bitumens; stones, twines, ropes, wires, khaki cloths, fuels, etc.; and the standardization of other classes of supplies.

Routine.—The routine work accomplished by the division of general, inorganic, and physical chemistry is shown in the following classified summary:

Nature of material or work.	1914	1915
Metals and alloys	51	44
Rocks, minerals, natural pigments, and similar substances		15
Clays, shales, limestones, limes, wall plasters, cements, and slags	11	5
Fertilizers	14	34
Soils and similar substances	42	365
Coal analyses	22	50
Calorimetric tests of fuel	7	34
Waters	208	201
Crude chemical and miscellaneous analyses	88	135
Standard solutions	30	20
Physical tests of wire, twine, fiber, textile, paper, and similar articles	31	32
Cements	6,817	6,716
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	86	203
Standardization of road materials	15	71
Standardization of units of measures:		
Lengths	171	60
Capacities	312	121
Weights	776	31
Miscellaneous	41	22

Mr. King has given the course of instruction in cement testing offered by the College of Engineering of the University of the Philippines. From time to time the division also has assisted the division of mines with the assays for gold and silver.

DIVISION OF ORGANIC CHEMISTRY

Personnel.—The year was begun with Dr. D. S. Pratt, chief of the division, Dr. H. C. Brill, and Messrs. L. W. Thurlow, A. H. Wells, F. Agcaoili, Lorenzo de Arego, and Hermenegildo Taguibao. The resignation of Doctor Pratt, who had been absent on leave since May 15, 1914, was accepted during the year. Dr. H. C. Brill has acted as chief of the division throughout the year. Mr. de Arego resigned, effective June 3, 1915. Mr. Thurlow, who is regularly stationed at Iloilo, went on leave to the United States on May 15 and returned to Manila December 3, 1915. During the absence of Mr. Thurlow the work at the Iloilo sugar laboratory was cared for by the detail of Mr. Wells and of Mr. Agcaoili during alternate periods. September 28, 1915, Mr. Wells left for the United States on vacation leave. Due to resignations and absences on leave the division has been reduced to an average of only about three men, which has made it very difficult to keep the work going. On account of this shortage Mr. Fr. W. C. Hauch was temporarily employed from February 20 to October 15, 1915. Mr. H. O. Parker, a graduate of Wabash College and for one year a graduate student at the University of Pittsburg and for three years a graduate student at Princeton University, arrived from the United States and began duty on August 1, 1915. Even yet the division is somewhat short-handed.

Routine.—One employee of the Bureau of Science is a member of the Food and Drug Board and meets with this Board to render decisions on all questions concerning the violation of the Food and Drugs Act. As imposed by law the organic chemists have continued to examine foods and drinks for adulteration or misbranding under Act No. 1655 and medicines and medical appliances examined for violation of Act No. 2342 in an effort to allow only pure foods, good general commodities, nonfraudulent medicines and therapeutic appliances and practices, and legitimate advertising of the same to be circulated in the various avenues of trade of the Philippine Islands. The war has decreased the imports to the Islands from Europe by cutting off our regular supplies from the belligerent countries, but it has brought about a larger influx of food supply from China and Japan, and these should have a much closer inspection than our former supplies from Europe. The Legislature very wisely passed an

amendment to the Food and Drugs Act, requiring that all food samples have the quantity of the contents stated on the label. The enforcement of this amendment has been postponed until foreign manufacturers could be informed of its provisions. However, it is now in effect. The results of the war and the new legislation are very much to increase the burden of work of this branch of the Bureau of Science. The Legislature has shown its interest in this work by the judicious laws that it has passed, and the personnel for the enforcement of the laws should be provided as requested in my appropriation estimate. Besides foods, drinks, and drugs, all oils, sugar and sugar products, toxicological and clinical specimens, opium, prohibited alkaloids, commercial and miscellaneous organic samples, and work connected with legal cases form a part of the regular routine work of the division of organic chemistry. Several thousand such samples have been examined during the year as shown by the following classified summary:

Nature of sample.	Examined under Acts 1655 and 2342.	Violation of Act 1665.	Government work.	Private work.	Total samples submitted.	
					1915	1914
Alcoholic liquors	12	10	34	4	38	16
Cereals and cereal products	2,059	7	2,083	17	2,100	57
Clinical examinations other than urines			18	3	21	42
Commercial and miscellaneous			37	53	90	123
Condiments	5	5	4	5	9	11
Dairy products	93	22	97	32	129	66
Drugs and medicines	[a]117	68	117	8	125	33
Essences	3	3	3	12	15	33
Fruits and fruit products	29	23	32	8	40	11
Meats and meat products	82	19	82		82	19
Mineral and vegetable oils			31	8	39	23
Nonalcoholic drinks	113	30	115	2	117	46
Opium and legal cases			44		44	44
Papers and textiles			114	2	116	109
Raw sugar and sugar cane			69	157	226	308
Sugar products			28	11	39	2
Urines			129	48	117	316
Vegetables	144	35	242	1	243	35
Total	2,657	222	3,279	371	3,650	1,294

[a] Sixty-seven were in violation of Act No. 2342.

The large number of examinations of cereal products is due to the campaign carried on by the Philippine Health Service and the Bureau of Science in conjunction with the Board of Food and Drug Inspection against the use of saccharine. The use of saccharine as a sweetening agent for soft drinks was rather

general for a short period, and there was an inclination on the part of bakers to use it. An interesting result of this campaign was that in no case was any sample of bakery product found to be adulterated with saccharine. Only prompt action prevented its use from becoming more widespread.

Iloilo sugar laboratory.—During the year 3,560 samples of sugar were polarized at the Iloilo sugar laboratory. This shows the eagerness with which both producers and dealers avail themselves of umpire polariscopic analysis in case of dispute and as a basis for valuation. Through the Iloilo sugar laboratory we have been able to give instruction with regard to mill practice and more perfect recovery of sugar. As much assistance as possible in many factories has been given in order to secure the best results with the facilities at hand.

My recommendations with regard to the extension of the work of the Iloilo sugar laboratory are made separately on page 53.

DIVISION OF MINES

Personnel.—Mr. Wallace E. Pratt, chief of the division of mines, after some five and one-half years of continuous service, was granted leave of absence with permission to visit the United States and left on the July transport for San Francisco. In order that he might accept a Yale fellowship in economic geology and spend six months in study, which will greatly increase his efficiency in the Philippine Islands, I have extended his leave of absence, without pay, until July, 1916. Mr. V. E. Lednicky has been acting chief of the division during the absence of Mr. Pratt. Mr. John P. Goldsberry has been appointed a geologist in the Bureau of Science; he sailed from San Francisco on December 18 and should be ready for duty in January. The division of mines has been seriously handicapped by a small staff during the past year, but an attempt has been made to handle all routine work presented. With the assistance of men in other divisions this has been accomplished without serious confusion.

Routine.—A greatly increased number of consultations have been held, and during the year 460 assays, 29 bullion smeltings, and 266 placer weighings have been performed. Two milling and cyanide tests also were made. All of this work shows a marked increase over the previous year, demonstrates the assistance which the Bureau of Science can render to those interested in mining, and indicates a growing confidence on the part of the mining men. The employees in the division of general, inorganic, and physical chemistry have rendered valuable assistance

with the assay work from time to time. A new assay balance with the greatest accuracy obtainable has been ordered and will be the standard for work in the Far East. For the benefit of the chemists and geologists a combination gas and gasoline muffle furnace has been constructed. With the gas, coal, and gasoline furnaces on hand almost any kind of assay work can be handled expeditiously.

The core samples from about 75 artesian wells were examined during the year. A large number are on hand to be examined, but the pressure of work along other lines has caused considerable delay in handling these samples, and we are badly behind. The work of examining mineral specimens and rocks continues daily, and an increased interest in the rarer minerals is being manifested by those who have had some experience in mineralogy. About 300 mineral specimens have been examined free of charge. When I returned to duty from the United States, I brought with me samples of the commonest radium ores of Colorado. They are on display at the Bureau of Science and have been especially called to the attention of prospectors in the Philippines in order that they might be on the lookout for the occurrence of similar ores.

The usual drafting necessary in the preparation of maps and drawings for publication in the Philippine Journal of Science has been carried on and in addition a great many placards were made for the exhibit of this institution at the Northern Luzon Fair. The draftsmen showed their interest in the affairs of the Bureau of Science by doing a great deal of overtime work in preparing models for this exhibit.

Field work.—The Bureau of Science has not been able to keep up with the demand for mine examinations and other geologic work. During the year the geologists have made professional examinations of the limestone deposit near Laguna de Bay, the Surigao iron-ore deposit and the neighboring gold deposit, the Leyte oil and asphalt deposit, the Lubang oil deposit, the Cabu River placer deposit, the Acupan mining property, and the Benguet Consolidated Company mining property. Several of these examinations were paid for by private parties. A geologist made several trips to Mindoro and while there made geologic examinations for private parties, studied the geology of the island, and investigated the occurrence of quartz sand. We have had a number of demands for good quartz sand for molding purposes, for cleaning castings, for cement work, for pottery use, and as a smelter flux. There is an abundant supply of quartz sand near Puerto Galera, Mindoro, suitable for such

purposes. The last week of the year was utilized in consultation work at Baguio in connection with the Northern Luzon Fair.

Mining legislation.—The past year has been marked by much interest in legislation concerning mining. The tax placed on the gross output of mines has not affected the mining industry as much as was anticipated by those interested in mines. No company was forced to stop operation because of its application. The Bureau of Science has furnished information during the year on the wharfage tax. There can be no doubt that this tax holds back mineral exportation, and it remains for the Legislature to decide whether the mineral resources of the Islands should be developed or should be conserved. The division of mines of the Bureau of Science is in a better position to know the needs of the mining people, the mineral possibility of the Philippine Islands, and the defects and needed changes in the mining laws than any other department of the Government, and any proposed changes or new laws should be referred to the Bureau of Science for study. Some of the old Spanish laws in regard to locating and working claims could be adopted to advantage. Under the present system a great deal of ground is being held for speculation, and development is retarded.

Publications.—The papers that the scientists of this division have contributed to the Philippine Journal of Science are included in the list given on page 45. Numbers 3, 4, and 5 of the Philippine Journal of Science, Section A (1915), Volume X, were devoted entirely to geologic papers. The Mineral Resources of the Philippine Islands for 1914 has been printed and distributed. It contains the following articles:

Staff, division of mines, Bureau of Science.
Review of Philippine mining in 1914, by Wallace E. Pratt.
Statistics of mineral production in the Philippines in 1914, by Victor E. Lednicky.
Gold production of the Philippine Islands in 1914, by Wallace E. Pratt.
Gold mining in the various districts in 1914, by Wallace E. Pratt.
Production of iron and nonmetals in 1914, by Wallace E. Pratt.
Copper deposits in Zambales Province, by Victor E. Lednicky.
Notes on the mineral resources of Surigao Province, by Wallace E. Pratt.
The Lubang gold district in southern Benguet, by Victor E. Lednicky.

In spite of the general unsatisfactory economic conditions throughout the world Philippine mining has made much progress, and during the latter part of the year a decided boom has been apparent. There remains a great deal of work to be done along geologic and mining lines in the Philippine Islands, and it is to be regretted that the personnel of the division of mines of the Bureau of Science is so restricted.

PHILIPPINE MUSEUM

The best of the museum exhibit was sent to San Francisco as a part of the Bureau of Science exhibit at the Panama-Pacific International Exposition. The Bureau of Science display consisted of about 4,000 items representing the following:

1. Applied chemistry in Philippine industry, including numerous samples of wood distillates and charcoals; tan barks; tanning cutch and tanned hides; paper made from local fibers; fruit products; essences; oils and beverages; information with regard to Philippine water supply from sanitary and commercial standpoints; Philippine coals, their analyses and results of physical and chemical tests; cement and concrete; limestone and lime from local resources; sand-lime bricks; tile; clay products and polished artificial marbles made from Philippine raw materials; various products from leaves, for example, roselle; and nipa palm and its products.
2. Philippine mineral resources and geology, including ores, coal, corals, fossils, and shells; models of Philippine processes and of gold production by years; relief maps; geologic and mineralogic maps; charts showing economic mineral products by years and distribution; and photographs.
3. Philippine ethnology, portraying the life, industries, and occupations of people in the Philippines, including everything from small ornaments, cloths, and garments to weaving looms, household utensils, tools, agricultural implements, fishing boats, and even models of their houses; and miscellaneous industries, such as fish, hemp, rope, basket, and hat making.
4. Philippine economic fishery products and resources, including food and game fishes, window and button shells, tortoise shell, and sponges.
5. Mounted Philippine botanical specimens.
6. An exhibit of the Philippine Journal of Science and colored transparencies illustrating the Philippine Islands.

The exhibit was exceedingly well received in San Francisco. It was packed and completely prepared for return to the Philippine Islands on January 1, 1916, and will be returned on the United States Army Transport leaving San Francisco in February, 1916. The Government deemed it unwise to leave the museum building only partly occupied when the space was needed. Accordingly the specimens left in Manila were stored, and the building on Calle Juan Luna was vacated for the use of the Bureau of Forestry as an office building. The Sales Agency Building on the Luneta extension near the Manila Hotel has been assigned to the Bureau of Science, and the material returned from San Francisco and other material now on hand in the Bureau of Science will be segregated here for a commercial, industrial, and general museum of the Philippine Islands. We shall begin its arrangement about April 1 after the San Francisco exhibit arrives.

LIBRARY

Personnel.—Miss Mary Polk remains as chief librarian. The loss of Miss Lucia May Brooks, who left Manila in June to

return to her regular duties in the library of Leland Stanford Junior University after a year in the Orient, was keenly felt. No trained technical assistant has been secured in her place. Mrs. Mary L. Crozier, employed on April 19, 1915, has been very helpful in certain branches of the work, but is not trained for technical work. No other changes were made during the year except in the temporary apprentices.

Routine.—The following table gives the record of technical work performed:

	Titles.	Volumes.	Parts.	Cards.
Classification and cataloguing	771	2,926	1,821	4,923
Reclassification and cataloguing	79	466		717
Total	850	3,392	1,821	5,640
Printed cards				10,419
Total cards filed in official catalogue				16,059

The accessions during the calendar year were 1,172 volumes, making a total of 32,032 bound volumes in the library on December 31, 1915. Work with printed cards has been carried forward as rapidly as possible. In no other part of the library are we getting as much for the money expended as through the addition of Library of Congress cards, which we are making regularly to our official catalogue. Valuable exchange material and gifts are received regularly in large quantity. Four thousand volumes were prepared and sent for binding during the year. An inventory undertaken during the year is nearly completed. During the year six double sections were added to the stacks, giving approximately 1,500 feet of much needed additional shelving.

Cuts.—There were 4,910 cuts in place at the end of the year; approximately 150 remain unentered.

Bound sets of the Philippine Journal of Science.—The demand for bound sets of the Philippine Journal of Science now on the shelves of the library has been so great that it was decided to bind six additional sets from the reserve stock formerly set aside to meet this demand and to provide for permanent preservation of these sets.

Union catalogue.—The Library of Congress proof sheets, which we cut and file as a reference catalogue, were filed to date until about the middle of the year. Since that time the galleys have accumulated, and we now await opportunity again to bring this work up to date. This reference catalogue, now occupying 288

standard cabinet trays, is easily the best single reference tool in the Philippine Islands.

Use.—The library serves not only the workers in the Bureau of Science, but all scientific workers in the Philippine Islands, including representatives of the United States Army, the United States Navy, the United States Marine Corps, the United States Public Health Service, and other Federal departments, the other bureaus of the Insular Government, the professors and students in all the colleges of the University of the Philippines, students of the schools of Manila, outside visitors, etc. The average daily circulation was over 49, and the average number of publications returned daily was over 40, leaving 3,341 more publications charged at the end than at the beginning of the year. Closer check over the circulation is necessary for efficiency, but the pressure of other work has prohibited any change in method during the year.

Library training.—The librarian and assistant librarian of the Bureau of Science conducted the work of the Library training class of the College of Liberal Arts of the University of the Philippines from February 1 to the end of the college year. The third-year class of the College of Medicine and Surgery received lectures on elementary methods in library usage during the second half of the college year 1914-15, while the fifth-year class received seven lectures, with practice in the library during the first half of the college year 1915-16. Each student in these courses was taught the use of the more important reference tools in scientific subjects and was required carefully to prepare a bibliography on one medical subject.

THE PHILIPPINE JOURNAL OF SCIENCE AND OTHER PUBLICATIONS

During 1915 the Philippine Journal of Science was issued as usual in four sections, each of which contained six numbers, somewhat smaller than heretofore. Each section is separately paged and indexed. The following table shows the number of pages, plates, and text figures contained in each section of Volume X:

	Section A.	Section B.	Section C.	Section D.
Pages	408	394	434	416
Plates	30	15	19	24
Text figures	40	89	----------	63

The numbers of the Philippine Journal of Science for Volume X, 1915, contain the following articles. Names of members of the Bureau of Science staff are marked by asterisks.

SECTION A. CHEMICAL AND GEOLOGICAL SCIENCES AND THE INDUSTRIES

No. 1, January, 1915

*Pratt, David S. Papain: Its commercial preparation and digestive properties.
Blackwood, O. H. A determination of the diurnal variation of the radioactivity of the atmosphere at Manila by the active deposit method.
*Gibbs, H. D., and *Brill, H. C. Diethylsuccinosuccinate (ethyldioxydihydroteraphthalate): A study of its constitution, some derivatives, and absorption spectra.
*Heise, George W. Water supply for the city of Iloilo.
———. Boiler water of Iloilo Province.
*Smith, Warren D., *Eddingfield, F. T., and *Fanning, Paul R. A preliminary check list of Philippine minerals.
Reviews.

No. 2, March, 1915

*Gibbs, H. D. Proposed modification of ylang-ylang oil standards.
*Brill, Harvey C., and *Agcaoili, Francisco. Philippine oil-bearing seeds and their properties: II.
———. The enzymes of cacao.
*Heise, George W. Water supplies in the Philippine Islands: II.
Reviews.

No. 3, May, 1915

*Smith, Warren D. Notes on a geologic reconnaissance of Mountain Province, Luzon, P. I.
———. Notes on the geology of Panay.

No. 4, July, 1915

*Pratt, Wallace E. The location of artesian wells in the Philippine Islands from a geologic viewpoint.
———. Petroleum and residual bitumens in Leyte.
———. On the occurrence of petroleum in the Province of Cebu.

No. 5, September, 1915

*Pratt, Wallace E. The persistence of Philippine coal beds.
———. Geologic reconnaissance in Caramoan Peninsula, Camarines Province.
———. Iron ore on Calambayanga Island, Mambulao, Camarines.
———, and *Lednicky, Victor E. Iron ore in Surigao Province.

No. 6, November, 1915

*Gana, Vicente Q. The leather industry of the Philippine Islands.
*Cox, Alvin J., and *Dar Juan, T. Salt Industry and resources of the Philippine Islands.

SECTION B. TROPICAL MEDICINE

No. 1, January, 1915

Munson, E. L. Cholera carriers in relation to cholera control.
*Schöbl, Otto. Observations concerning cholera carriers.
Wharton, Lawrence D. The development of the eggs of Ascaris lumbricoides.

*Ruediger, E. H. The occurrence of Bacillus coli communis in the peripheral blood of man during life.

———. The preparation of tetanus antitoxin.

Calderon, Fernando. Cæsarean section in the Philippine Islands.

Woodward, R. B. Case report of obstructed labor and cæsarean section.

Thornburgh, Robert M. Adenocarcinoma of the cæcum, complicated by intussusception.

DuMez, A. G. Two compounds of emetine which may be of service in the treatment of entamœbiasis.

Albert, José. The treatment of infantile beriberi with the extract of tiqui-tiqui.

Philippine Islands Medical Association. Minutes of the eleventh annual meeting, held at Manila, November 4–7, 1914.

Editorial. Progress in the investigation of vitamines.

Review.

No. 2, March, 1915

*Williams, R. R., and Saleeby, N. M. Experimental treatment of human beriberi with constituents of rice polishings.

———, and *Crowell, B. C. The thymus gland in beriberi.

*Schöbl, Otto. Practical experience with some enriching media recommended for bacteriological diagnosis of Asiatic cholera.

*Barber, Marshall A. I. Experiments on the immunization of guinea pigs by the inoculation of avirulent tubercle bacilli in agar. II. Observations on animals inoculated with tuberculosis from lepers.

———, and Jones, Charles R. A test of Coccobacillus acridiorum d'Herelle on locusts in the Philippines.

No. 3, May, 1915

*Barber, M. A.; *Raquel, Alfonso; *Guzman, Ariston; and *Rosa, Antonio P. Malaria in the Philippine Islands. II. The distribution of the commoner anophelines and the distribution of malaria.

No. 4, July, 1915

*Crowell, B. C. Pathologic anatomy of bubonic plague.

No. 5, September, 1915

Roberg, David N. The rôle played by the insects of the dipterous family Phoridæ in the spread of bacterial infections. Experiments on Aphiochæta ferruginea Brunetti with the cholera vibrio.

*Williams, Robert R., and *Johnston, John A. Miscellaneous notes and comments on beriberi.

Schüffner, Wilhelm. Pseudotyphoid fever in Deli, Sumatra (a variety of Japanese kedani fever).

Reviews.

No. 6, November, 1915

Denney, Oswald E. The treatment of the retrogressive skin lesions of leprosy with basic fuchsin.

*Johnston, John A. Leprosy.

Calderon, Fernando. Tropical obstetrical problems.

Coulter, J. S. A study of the pathology of the gall bladder and biliary passages in cholera.

SECTION C. BOTANY

No. 1, January, 1915

*Merrill, E. D. New or noteworthy Philippine plants, XI.

No. 2, March, 1915

Patouillard, N. Champignons des Philippines communiqués par C. F. Baker, II.
*Merrill, E. D. Studies on Philippine Rubiaceae, II.
Copeland, E. B. Notes on Bornean ferns.
Review.

No. 3, May, 1915

*Merrill, E. D. The present status of botanical exploration in the Philippines.
———. Genera and species erroneously credited to the Philippine flora.
———. New species of Schefflera.
———. New species of Eugenia.

No. 4, July, 1915

*Merrill, E. D. Studies on Philippine Anonaceae, I.
———. Plantae Wenzelianae, III.

No. 5, September, 1915

*Merrill, E. D. New or noteworthy Philippine plants, XII.

No. 6, November, 1915

Rundles, John C. Studies in rice.
Teodoro, Nicanor Gregorio. A preliminary study of Philippine bananas.

SECTION D. GENERAL BIOLOGY, ETHNOLOGY, AND ANTHROPOLOGY

No. 1, January, 1915

Light, S. F. Notes on Philippine Alcyonaria. Part III: Two new species of Lithophytum Forskål from the Philippines.
Cowles, R. P. The habits of some tropical crustaceans.
Heller, K. M. Neue Käfer von den Philippinen: II.
Baker, C. F. Studies in Philippine Jassoidea: II, Philippine Jassaria.
Griffini, Achille. Prospetto dei Grillacridi delle Isole Philippine.
Poppius, B. Neue orientalische Bryocorinen.

No. 2, March, 1915

Taylor, Edward H. New species of Philippine lizards.
Wharton, Lawrence D. The eggs of Ascaris lumbricoides.
Bernhauer, Max. Zur Staphylinidenfauna der Philippinen: VI. Beitrag zur Kenntnis der indo-malayischen Fauna.
Grouvelle, A. Dryopidæ et Heteroceridæ des Philippines.
Baker, C. F. Notices of certain Philippine Fulgoroidea, one being of economic importance.
Cowles, R. P. Are Atya spinipes Newport and Atya armata Milne Edwards synonyms for Atya molluccensis De Haan?
Light, S. F. Notes on Philippine Alcyonaria. Part IV: Notes on Philippine Stolonifera and Xeniidæ.

No. 3, May, 1915

Kemp, Stanley. On a collection of stomatopod Crustacea from the Philippine Islands.
Baker, C. F. Studies in Philippine Jassoidea: III, The Stenocotidæ of the Philippines.
Light, S. F. Notes on Philippine Alcyonaria. Part V: Cornularia minuta, a new species.
*Seale, Alvin. Note regarding the dugong in the Philippine Islands.

No. 4, July, 1915

Heller, K. M. Neue Käfer von den Philippinen: III.
Baker, C. F. Two Amphipoda of Luzon.
Crawford, D. L. Ceylonese and Philippine Psyllidæ (Homoptera).
*Schultze, W. Erster Beitrag zur Coleopteren Fauna der Philippinen.

No. 5, September, 1915

Wileman, A. E. Notes on Japanese Lepidoptera and their larvæ: Part II.
Day, Artemas L. Difficulties encountered in the culture of bañgos, or milkfish, in Zambales Province.

No. 6, November, 1915

Baker, C. F. Studies in Philippine Jassoidea, IV: The Idiocerini of the Philippines.
Wileman, A. E. Notes on Japanese Lepidoptera and their larvæ: Part III.
Funkhouser, W. D. Review of the Philippine Membracidæ.

The Mineral Resources of the Philippine Islands for 1914 was issued during the year, as was also a small pamphlet entitled Birds in their Economic Relation to Man. The new publication folder which was sent to press in 1914 was issued early in 1915. Translations into Spanish entitled "La industria de curtidos en las Islas Filipinas" and "La fabricación del azúcar" were issued. These pamphlets are for free distribution.

A catalogue of Philippine Coleoptera, consisting of about 200 pages, was received in first revised page proof at the end of the year.

The serial numbers and the titles of press bulletins issued during the year are as follows:

No. 35. Notas de interes para los hacenderos de azucar. [January 28, 1915.]
Leaflet. Notas de interes para los hacenderos de azucar. [February 18–23, 1915. Silay Exposition and Carnival.]
No. 36. Investigation of iron-ore deposits in Surigao, Mindanao. [February 6, 1915.]
No. 37. Philippine gold production for 1914 shows great increase. [February 6, 1915.]
No. 38. Mosquitoes and malaria in the Philippine Islands. [February 8, 1915.]
No. 39. The return to Manila of the Bureau of Science party which made a survey of the iron ore in Surigao Province. [March 31, 1915.]

No. 40. New gold mining near Iligan, Mindanao. [April 14, 1915.]
No. 41. La mejora de la industria del curtido de las Islas Filipinas. [May 20, 1915. Spanish.]
No. 42. Asphalt in Leyte. [June 10, 1915.]
No. 43. Copper deposits in Zambales Province. [June 15, 1915.]
No. 44. Rock asphalt in Leyte. [July 2, 1915.]
No. 45. Iron-ore deposits in Surigao. [July 13, 1915.]
No. 46. Copra: Fifteen million pesos loss of the Philippine industry in five years. [October 14, 1915. English and Spanish.]
No. 47. Rabies in the Philippine Islands. [October 22, 1915. English and Spanish.]

A ten-year index of the Journal was begun in October. During two months about 30,000 cards were typed, but toward the end of the year practically nothing was done on the index owing to more urgent work in other lines.

The blanks and labels required by the various divisions have been printed.

The mailing list of the Philippine Journal of Science for the past two years has been as follows:

	1914	1915
Paid subscriptions	347	320
Exchanges	465	470
Reviews	64	66
Free	49	49
Total mailing list	925	905

Owing to the general unstable business conditions throughout the world as a whole, it is gratifying that the Philippine Journal of Science has been so fortunate as to retain its paid subscription list practically unchanged.

POWER PLANT

Personnel.—There has been no change in the engineering personnel. It has remained as heretofore, entirely Filipinized, with Mr. José Guerrero y Reyes as chief power engineer and Mr. Felix Valencia as assistant engineer.

Power.—During the year the supply of gas for the Philippine General Hospital and the Colleges of Medicine and Surgery and of Liberal Arts was closed. The Manila Gas Corporation is now operating a city supply and is furnishing these institutions. The Philippine General Hospital steam supply was closed on December 15, it having been decided that it was cheaper to use gas than steam for cooking purposes, especially when steam had to be delivered so far. The other functions of the central power

plant for the Philippine General Hospital, the Bureau of Science, and the College of Medicine and Surgery remain unchanged.

Producer-gas plant.—The producer-gas generator and the gas engine have proved their reliability and economy under intelligent supervision and care.

Boiler plant.—The two Dutch ovens installed last year in front of the two old boiler units are satisfactory. The arrangement produces complete combustion. The improved furnaces produce such intense heat with the present baffling system that no fire brick can stand it for a long time. The baffles have to be repaired every few months to maintain smokeless operation. With intelligent firing the smoke now emitted from the chimney is negligible. The plan that we have used can be advantageously followed elsewhere for the prevention of smoke. The boilers can stand a higher overload now than before the modifications were made.

Costs.—The average cost per kilowatt hour of electric current was slightly over 10 centavos. This was somewhat higher than during the former year due to the increased cost of coal. The cost of the production of electric current could be considerably reduced by the addition of another producer-gas generator.

Mansfield gas-generating plant.—The total gas generated was more than 700,000 cubic feet (19,824 cubic meters). The cost of production has been considerably lowered by the use of naval fuel oil in the retorts and dilution with producer gas.

Shop.—The number of shop requests is shown by the following table.

	Requests.
Bureau of Science	305
Bureau of Public Works	1
Bureau of Health	1
Private	5
Total	322

CLERICAL DIVISION

The clerical work of the Bureau of Science has progressed and has been a satisfactory tool in the scientific work of the institution. Chief Clerk A. E. Southard returned from his detail as private secretary to the Honorable, the Secretary of the Interior, on February 15 and on March 26 went on leave to China and returned to duty in the Bureau of Science on September 1. During his absence the duties of chief clerk were performed by Mr. C. J. Stancliff, property officer, cashier, and disbursing officer. Mr. Harold Evans was transferred in August from the Bureau of Science to the Department of Police

of the city of Manila for the reason that he was offered a higher salary there than was available in the Bureau of Science. Mr. L. G. Thomas was appointed as a temporary employee on December 1 to the place left vacant by the transfer of Mr. Evans.

During the middle of the year representatives of the Insular Auditor were engaged in making a complete inventory of the property, equipment, and supplies of the Bureau, and since the return of the chief clerk, Mr. Stancliff and the other members of the property office have been working long and hard in checking the inventory.

The improvement of the Bureau of Science grounds is being carried on, as it can be done economically. Many low levels have been raised by excavating the good earth and filling below with ashes from the power plant. The grounds have also been beautified by rearranging the ornamental shrubbery and the mulberry bushes that furnish food for the silkworms. In some places a single, red hibiscus has been substituted for the "violeta" as a hedge plant. The janitor and his assistant have taken particular interest in thus grading and beautifying the grounds. The breeding of guinea pigs has continued successfully. We not only have sufficient for supplying the needs of our medical laboratory, but have a surplus for other institutions. We have had also some success with breeding rabbits.

PHOTOGRAPHY

The record of the photographic work is as follows:

Nature of work.	Calendar year 1914.	Calendar year 1915.
Negatives taken or developed	458	374
Lantern slides	875	434
Prints, 5 by 7 inches	10,718	3,185
Prints of various sizes		963
Enlargements	262	50
Transparencies, 8 by 10 inches	53	3

AQUARIUM

The aquarium of the Bureau of Science has continued to be much appreciated. It is clearly one of the most attractive diversions in Manila, and I have received many letters commending it. The aquarium is self-supporting. There were enough paid admissions during the year to reimburse the Government for its upkeep. I have continued to admit students and teachers of schools by special arrangement. This has been very much appreciated, and during the year there were 16,369 free ad-

missions. In the aquarium at present there are over 700 specimens, representing 202 species of fishes and various species of crabs, lobsters, prawns, turtles, crocodiles, etc. The clerical work in connection with the aquarium at first caused considerable overtime work, but now it has been systematized to such an extent that all work in connection therewith is performed efficiently with very little effort.

BUREAU OF SCIENCE EXHIBIT AT THE NORTHERN LUZON FAIR

The Bureau of Science sent to San Francisco for the Panama-Pacific International Exposition 72 large packing cases filled with exhibits, so that material for the Northern Luzon Fair had to be drawn from residual material and that accumulated during the year. However, a very creditable mining, chemical, and photographic display was arranged. Baguio, Benguet, where the fair was held, is the center of a mining district, and for that reason the mining exhibit of the Bureau of Science attracted unusual attention. A geologist accompanied the exhibit and was able to give valuable information to visitors at the fair interested in chemical and mining problems. Several hundred copies of our catalogue of publications and of the pamphlet entitled Industrial Resources of the Philippine Islands were distributed.

RECOMMENDATIONS

During the past calendar year we have had available for the work of the Bureau of Science ₱379,890. I have annually pointed out that the work of maintaining a constantly growing bureau, which in effect is a department of information and must keep abreast with development in many lines, is much handicapped by an insufficient appropriation. During each of the last three years there has been an increase in the amount of fixed work and a decrease in the appropriation. It follows that many important constructive problems remain untouched. Progressive work should be carried on all the time to prevent expensive duplication and waste and to attract and hold good men. From the foregoing pages it is clear that there is the greatest need of more scientific employees.

The Bureau of Science is charged by law with the performance of the laboratory work necessary for the enforcement of the sanitary measures in the Philippine Islands. We should have personnel sufficient to combat any epidemic that may arise; when epidemics are under control, we should carry on investiga-

tions such as those that have led to the control of entamœbic dysentery and the isolation of the cholera carrier.

Each year shows more clearly that thousands of pesos could be saved annually to the sugar growers alone, if they had the scientific information necessary with regard to planting, harvesting, and recovering sugar most efficiently and economically. More perfect extraction and more careful handling of the juice should increase the production and improve the quality of the sugar, even if there is no increase in the yield or in the planted area. The best way to improve and increase the sugar production of the Philippine Islands is by the careful application of scientific knowledge.

Many hacenderos in Negros believe that there is a secret process in the manufacture of sugar. A prominent planter told me that it was impossible to get more than 77-degree sugar from one cane, which gives a dilute juice, whereas he got 88-degree sugar from another variety. In the same way I was told that it was impossible to manufacture sugar from nipa juice, because it would ferment. We easily overcame the effects of the oxidase secreted by the nipa palm in the latter case, and similarly we can overcome the former difficulty, if we have trained men to send into the field to study conditions as they actually exist. I should like to send a staff to Negros with a field laboratory to make analyses and to give lectures and demonstrations throughout the province and thus efficiently make the hacenderos familiar with the principles of sugar making and of training sugar-mill laborers in the necessary manipulation in the factory. There should be employees enough to give instruction and information on subjects such as the following:

1. The necessity for determining the purity of the cane before cutting.
2. The advantages to be gained on large haciendas by planting the Cebu, the Inalmon, and the Lahaina varieties in addition to the Moradi cane. With such a diversity the milling period would be greatly lengthened, and the cutting of overripe or underripe cane could be avoided.
3. The construction and the arrangement of the mill and of the means for conveying the cane to the mill.
4. The care and the storage of cut cane.
5. Cleanliness and proper sterilization in and around the mill.
6. The efficiency of formaldehyde as an antiseptic for cleaning cauas, tanks, etc.
7. Proper extraction and proper handling of the juice before and during evaporation.
8. Purity and quantity of lime to be used, with a demonstration of the

quality produced in the Bureau of Science experimental kiln and instruction as to how proper kilns can be made and operated.

9. Harmful effects of a deficiency or excess of lime in the juices.
10. Demonstration to show that a dilute juice will produce a better sugar if mixed in proper quantities with a more concentrated juice and that a rapid rate of evaporation and rapid concentration of a dilute juice prevents the inversion of sugar and results in a better product.

No entomologist has been on duty in this institution for several months, but the need is exceedingly apparent. On October 18, 1915, I received a request from the Assistant Director of Health asking for the identification of Surigao specimens of bed bugs from a bed, lice from the hair of a woman's head, ticks from a hog, and flies from market refuse. I have just received a letter which reports a plague of centipedes on an island situated off the coast of Pangasinan between the municipality of Anda and that of Alaminos, which is "causing much pain and inconvenience" to the inhabitants. The report requests recommendation as to the best method of exterminating or reducing the number of centipedes. Whenever possible, work of this kind is performed by the Bureau of Science, but it is frequently accomplished by the generous assistance of a former employee now not connected with the Government. These are only two of many requests and indicate a large amount of experimental study and work in preparing information necessary to assist the Bureaus of Health, Forestry, Agriculture, etc.; in the study of poisonous insects and those responsible for the spread of disease; those injurious to timber trees, agricultural plants, etc.; and injurious insects that are held in check by birds, etc. Also entomologists will be of great assistance to the work of the sanitary commissions that are now in operation. The employment of at least two during 1916 is recommended.

The desirability of extending the silkworm industry within the Archipelago becomes more apparent each year. However, there seems to be a hiatus between the Bureau of Science and the people who could profit by the silk industry. The Bureau of Science has the information with regard to silk culture, silkworm eggs, and the mulberry trees, but no adequate method of inducing the people in the provinces to take up the industry. Demonstrators, preferably Filipinos, who should have Government support in establishing small silk farms in favorable localities so that the people could actually see the results that can be secured, should be used to induce the people of these Islands to engage in the industry.

The information we have with regard to the industrial, economic, and sanitary development of the Philippine Islands is not sufficiently used. I desire to emphasize the fact that there is extensive information along many lines in the Bureau of Science that should effect a large annual saving to the inhabitants of these Islands, if it were utilized. There is no adequate means of putting the people of the Islands in touch with this information. The best and probably the only way to interest those to whom the introduction of desirable modifications of existing methods is most important is by actual demonstration.

The suggestion has been made that the Philippine Journal of Science is not sufficiently popular in form. Popular information is only of passing interest, but the Philippine Journal of Science prints concise, accurately edited facts. By far the best plan is to publish concise, accurate, scientific literature and to bring this information to the inhabitants of these Islands by personal demonstration. We should have available in the Bureau of Science men whose work it should be to demonstrate the modifications in the drying of copra, the extraction and handling of the sugar-cane juices, the tanning of leather, the manufacture of lime, the extension of the silkworm industry, etc. Recently in my office a Spanish coconut grower discussed the drying of copra. He had lived in Laguna ever since American occupation of the Philippine Islands and had never before visited the Bureau of Science. His visit on this occasion was the direct outcome of a conversation with a representative of the Bureau of Science when the latter was in Laguna in the furtherance of our copra-drying propaganda. I recommend that provision be made for a corps of demonstrators in the Bureau of Science.

It is recommended that the Government provide for sending the most capable and advanced library assistants of the Bureau of Science to the United States for further professional training in order that the Philippine Islands may have available a group of trained employees for carrying on library work of a high order and for teaching in the library-training courses.

The matter of safe-guarding the herbarium has been brought up year after year. Somewhat over a year ago all types of Philippine plants were segregated and stored in separate cases, distinct from the general herbarium, in the concrete east wing of the Bureau of Science building. During my absence in the United States the entire herbarium, except the fungi, was transferred to the quarters in the new wing formerly occupied by the

entomological collection. While the new quarters are very cramped, very inconvenient, and necessitate the arrangement of the cases in tiers of three rather than in tiers of two, the inconveniences are to a degree offset by the knowledge that the large and valuable collection is now reasonably safe from destruction by accidental fire. It is to be hoped, however, that more adequate and better-arranged quarters can be provided in the near future, for now all work of consulting the herbarium is done with a very great loss of time and energy. Moreover the work is badly scattered. The herbarium occupies three rooms in the east wing, the mycologist is in a distant room in the main building, the physiologist is in still another isolated and distant room on the ground floor of the main building, while the botanical workroom is also distant from the herbarium near the physiologist's office.

Ever since the Bureau was organized, considerable attention has been given to the study of medicinal plants. Many data have been accumulated, and we now definitely know a large percentage of the plants actually used by the Filipinos in the practice of medicine. The commercial medicinal plants of the Philippines are few, but those utilized by the Filipinos total several hundred species. Very many of these have never been critically studied by chemists, pharmacists, and physicians, and it is probable that some of our numerous plants, on investigation, will prove to have distinct curative values. It is hoped that during the coming year we may be able to undertake a comprehensive survey of the medicinal plants of the Archipelago. The matter of classification will be simple, but the whole question is exceedingly complex and will involve coöperation of botanists, pharmacists, chemists, and physicians. It is believed that such coöperative work can be arranged, but primarily the inception of the work involves the addition of another member to the botanical staff whose major work shall be the general direction of the medicinal-plant survey.

Year by year I have pointed out the desirability of commencing a comprehensive, systematic enumeration of Philippine plants. The Philippines has a Flora de Filipinas, published in 1837, but the work is absolutely inadequate; even when published, it was obsolete in arrangement. Systematic botany is carried on by every government as a matter of pride and as a necessary part of its scientific work. What some other countries have done in the way of floras may be judged by the following:

India had a published flora as early as 1832, and it is but fifteen years since Hooker's Flora of British India was published. Flora Australiensis was published in 1860–75; Flora Hongkongensis, 1865; Flora of the British West Indies, 1862; Flora of Ceylon, 1890–1900; Flora of the Malay Peninsula, 1885–date; Flora von Nederlandisch Indie, 1855-60; Flora Capensis (South Africa), 1865–date; Flora of Tropical Africa, 1870–date; Flora de Indo-Chine, 1905–date. The Germans, the French, and the English are industriously turning out floras of their respective colonies, and even the Japanese are doing relatively more work on the flora of Formosa than the Philippine Government is doing on the flora of the Philippines.

Mr. Merrill has worked for twelve years on the flora of the Philippines, and his accumulated knowledge is worth much to this Government. It is improbable that any one else will ever be so well fitted for the preparation of a flora of the Philippines. I recommend that the personnel of the Bureau of Science be increased and so adjusted that he can devote a considerable uninterrupted time to the preparation of such a manuscript, in order that his knowledge of Philippine plants and of the literature relating to them will be in permanent form.

Year by year I have pointed out the need of funds for a new wing to supply adequate quarters and against possible destruction by fire of our scientific collections, funds for a soil survey, for the investigation of the subject of animal diseases, of insects injurious to agricultural products, a water survey, the purchase of books necessary to complete sets now in the central scientific library, reissuing of exhausted editions of certain publications, and enlarging the scope of our present work on the fish and fisheries of the Philippine Islands. These things are more and more urgently needed as time goes by.

Tables, showing the routine work performed and supplies manufactured and disposed of during the calendar year 1915 by the Bureau of Science, and the financial statement, showing the appropriation and how it was expended, are attached hereto.

Respectfully submitted.

ALVIN J. COX,
Director, Bureau of Science.

To the Honorable,
The SECRETARY OF THE INTERIOR.

TABLE I.—*Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1915, as compared with the fiscal year 1914, by number or quantity and by value, arranged by subdivisions of the Bureau of Science.*

Subdivision of the Bureau of Science.	Total work performed.		Cash work.			
	Samples or units.		Samples or units.		Pesos.	
	1914	1915	1914	1915	1914	1915
General, inorganic, and physical chemistry.						
Metals and alloys	51	44	32	18	436.50	243.00
Rocks, minerals, natural pigments, and similar substances		15				
Clays, shales, limestones, limes, wall plasters, cements, and slags	11	5	5	2	27.00	28.00
Fertilizers	14	34	12	22	132.00	246.20
Soils and similar substances	42	365	30		693.00	
Coal analyses	22	50	19	49	276.00	385.40
Calorimetric test of fuels	7	34	6	34	120.00	672.00
Waters	208	201	15	32	365.00	611.50
Crude chemical and miscellaneous analyses	88	135	58	115	289.50	497.00
Standard solutions	30	20	5	2	29.00	9.00
Physical tests of wire, twine, fiber, textile, paper, and similar articles	31	32	31	32	90.50	87.00
Cements	6,817	6,716	6,817	6,696	7,641.20	9,427.15
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	86	203	86	203	330.00	635.40
Standardization of road materials	15	71	15	71	170.15	467.40
Standardization of units of measures:						
Lengths	171	60	170	60	88.50	6.00
Capacities	312	121	312	121	99.40	27.10
Weights	776	31	776	31	79.95	16.95
Miscellaneous	41	22	41	22	54.00	15.50
Total	8,722	8,159	8,430	7,510	10,921.70	13,374.60
Organic chemistry.						
Urines, clinical and toxicological analyses	232	192	77	80	469.00	274.00
Essential oils and essences	14	11	13	11	89.50	77.50
Petroleum and products, copra, and similar materials	68	20	11	10	89.50	98.00
Paints, varnishes, and linseed oils	42	63	33	54	319.00	412.65
Gums, resins, and similar materials		1		1		5.00

TABLE I.—*Comparative table of routine work performed, etc.*—Continued.

Subdivision of the Bureau of Science.	Total work performed.		Cash work.			
	Samples or units.		Samples or units.		Pesos.	
	1914	1915	1914	1915	1914	1915
Organic chemistry—Continued.						
Paper and similar materials	104	117	----	----	----	----
Gastric juice, clinical examinations	52	2	3	2	15.00	95.00
Foods, alcohols, and beverages	640	2,921	256	245	884.00	951.20
Food preservatives and coloring matters	5	25	2	15	4.00	89.00
Medicines and similar articles	48	120	16	24	140.00	485.00
Miscellaneous chemical analyses and examinations	89	178	24	36	100.00	298.04
Total	1,294	3,650	435	478	2,110.00	2,785.39
Mines.						
Assays	411	677	403	650	653.45	957.76
Biological laboratory.						
Fæces	[a] 126,226	50,021	426	1,118	1,371.00	3,352.33
Sputum	2,095	85	36	21	108.00	63.00
Blood	6,398	29	140	22	422.00	210.00
Blood culture	392	2	4	2	20.00	10.00
Widal test	599	5,166	9	6	33.00	18.00
Wassermann test	1,259	633	304	257	3,040.00	2,502.88
Leprosy	1,132	569	3	----	9.00	----
Urines	4,275	2	81	1	242.00	25.00
Gonococci	16,379	15,832	24	10	72.00	30.00
Waters	2,243	2,986	8	11	320.00	350.00
Necropsies	401	117	----	----	----	----
Histological examinations	256	473	8	13	80.00	130.00
Rabies	36	21	----	----	----	----
Plague	65	1	----	----	----	----
Rats for plague	[a] 113,337	79,298	----	----	----	----
Miscellaneous biological examinations	1,755	10.035	58	9	548.00	48.00
Total	276,848	165,270	1,101	1,470	6,265.00	6,739.21
Serum section of the biological laboratory.						
Vaccine virus ---- doses	2,636,335	1,788,666	2,636,335	1,788,666	29,383.05	18,976.60
Antirinderpest serum ---- cc	134,333.33	----	134,333.33	----	230.29	----
Mallein ---- doses	815	10	815	10	545.50	10.00
Miscellaneous sera and preparations ---- cc	6,524,090	5,208,941	6,524,090	5,208,940	15,009.82	12,785.00
Total	9,295,573.33	6,997,617	9,295,573.33	6,997,616	45,168.66	31,771.60

[a] The two items "fæces" and "rats for plague" were excessive during 1914 on account of the presence of cholera and plague, and 110,244 more of these examinations were made in 1914 than in 1915.

TABLE I.—*Comparative table of routine work performed, etc.*—Continued.

Subdivision of the Bureau of Science.	Total work performed.		Cash work.			
	Samples or units.		Samples or units.		Pesos.	
	1914	1915	1914	1915	1914	1915
Miscellaneous.						
Photographs	16,161	4,971	14,339	4,020	4,956.54	1,403.60
Natural history specimens	8	82	8	82	81.24	208.48
Shop work	208	182	58	20	1,154.23	135.32
Miscellaneous work	52	17	52	17	8,081.52	5,249.94
Sales of publications					3,433.16	4,548.99
Refunded, work not done, etc. (deducted)					(82.75)	(102.50)
Power, gas, etc					31,995.70	31,125.23
Total	16,429	5,252	14,457	4,139	49,619.64	42,569.06
Grand total	9,599,277.33	7,180,625	9,320,399.33	7,011,863	114,738.45	98,197.62

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1915, as compared with the fiscal year 1914, by number or quantity and by value, arranged with reference to Government and other patronage.*

Patron.	Total work performed.		Cash work.			
	Samples or units.		Samples or units.		Pesos.	
	1914	1915	1914	1915	1914	1915
Bureau of Agriculture.						
Fertilizers	2	9				
Soils and similar substances	11	363				
Crude chemical and miscellaneous analyses		1				
Petroleum and products, copra, and similar materials	37					
Foods, alcohols, and beverages	64	29				
Miscellaneous chemical analyses and examinations	3	123				
Antirinderpest serum	134,333.33		134,333.33		230.29	
Mallein	300		300		30.00	
Photographic work	17	16	17	16	3.40	11.09
Standard solutions		1		1		5.00
Total	134,767.33	542	134,650.33	17	263.69	16.09

TABLE II.—*Comparative table of routine work, etc.*—Continued

Patron.	Total work performed. Samples or units.		Cash work. Samples or units.		Cash work. Pesos.	
	1914	1915	1914	1915	1914	1915
Bureau of Coast and Geodetic Survey.						
Miscellaneous sera and preparations		320		320		128.00
Bureau of Customs.						
Metals and alloys	1	4				
Waters:						
Chemical	1	1				
Biological	42	51				
Crude chemical and miscellaneous analyses	8					
Petroleum and products, copra, and similar materials		1				
Paints, varnishes, and linseed oils	1	1		1		4.00
Paper and similar materials	1					
Foods, alcohols, and beverages	7					
Medicines and similar articles	1	9				
Total	62	67		1		4.00
Bureau of Education.						
Fertilizers		2				
Foods, alcohols, and beverages		1				
Photographic work	1,799		1,799		347.30	
Total	1,799	3	1,799		347.30	
Executive Bureau.						
Photographic work	135	625	135	625	62.17	182.24
Bureau of Forestry.						
Soils and similar substances		2				
Petroleum and products, copra, and similar materials	2					
Photographic work	882	156	882	156	227.17	33.99
Total	884	158	882	156	227.17	33.99
Philippine Health Service.						
Metals and alloys	1	1				
Clays, shales, limestones, limes, wall plasters, cements, and slags	1					
Waters:						
Chemical	36	14				
Biological	1,012	1,062				
Crude chemical and miscellaneous analyses	3	6				

TABLE II.—*Comparative table of routine work, etc.*—Continued

Patron.	Total work performed. Samples or units. 1914	Total work performed. Samples or units. 1915	Cash work. Samples or units. 1914	Cash work. Samples or units. 1915	Cash work. Pesos. 1914	Cash work. Pesos. 1915
Philippine Health Service—Ctd.						
Fertilizers		1				
Urines, clinical and toxicological analyses	155	107				
Essential oils and essences	1					
Petroleum and products, copra, and similar materials		2				
Paints, varnishes, and linseed oils	2	5				
Gastric juice, clinical examinations	49					
Foods, alcohols and beverages	262	2,597				
Food preservatives and coloring matters	3	10				
Medicines and similar articles	13	73				
Miscellaneous chemical analyses and examinations	34	2				
Fæces	51,736	20,262	80		242.00	
Sputum	393	61	6		18.00	
Blood	4,393	7	134		404.00	
Blood culture	390		2		10.00	
Widal test	588	5,152	4		12.00	
Wassermann test	878	283	16		160.00	
Leprosy	1,108	569				
Urines	3,087	1	79		237.00	
Gonococci	16,319	15,822				
Necropsies	372	102				
Histological examinations	243	457				
Rabies	30	21				
Plague	43	1				
Rats for plague	113,288	79,032				
Miscellaneous biological work and examinations	1,638	10,021	4		28.00	
Vaccine virus	2,537,800	1,726,560	2,537,800	1,726,560	25,378.00	17,265.60
Miscellaneous sera and preparations	4,956,287	3,535,510	4,956,287	3,535,510	10,645.57	8,141.22
Photographic work	1,363	180	1,363	180	1,338.73	102.74
Shop work	13	1	13	1	29.73	8.66
Total	7,691,571	5,397,922	7,495,788	5,262,251	38,503.03	25,518.22
Bureau of Internal Revenue.						
Standardization of weights	25	7	25	7	2.50	2.45
Urines, clinical and toxicological analyses		1				
Medicines and similar articles	5	9				
Petroleum and products, copra, and similar materials		1				
Total	30	18	25	7	2.50	2.45

TABLE II.—*Comparative table of routine work, etc.*—Continued

Patron.	Total work performed. Samples or units. 1914	Total work performed. Samples or units. 1915	Cash work. Samples or units. 1914	Cash work. Samples or units. 1915	Cash work. Pesos. 1914	Cash work. Pesos. 1915
Bureau of Justice.						
Gastric juice, clinical examinations		2		2		95.00
Urines, clinical and toxicological analyses	12	1	12	1	220.00	20.00
Medicines and similar articles	22	14	13	14	85.00	140.00
Blood		2		2		150.00
Miscellaneous biological work and examinations	3		3		155.00	
Total	37	19	28	19	460.00	405.00
Philippine Constabulary.						
Physical tests of wire, twine, fiber, textile, paper, and similar articles	2	1	2	1	8.50	4.00
Sputum	1					
Wassermann test	1					
Vaccine virus	2,150	2,650	2,150	2,650	21.50	26.50
Miscellaneous sera and preparations		6		6		3.00
Photographic work		2		2		3.20
Total	2,154	2,659	2,152	2,659	30.00	36.70
Philippine Exposition Board.						
Photographic work	130	49	130	49	173.07	140.00
Shop work	20		20		522.59	
Total	150	49	150	49	695.66	140.00
Bureau of Printing.						
Paper and similar materials	100	117				
Medicines and similar articles		2				
Total	100	119				
Bureau of Prisons.						
Soils and similar substances	1					
Fæces	67,183	26,927				
Sputum	1,671	1				
Blood	1,999					
Widal test	6	8				
Wassermann test	92	93				
Leprosy	19					
Urines	1,186					
Gonococci	36					
Necropsies	29	15				
Histological examinations	5	3				
Plague	1					

TABLE II.—*Comparative table of routine work, etc.*—Continued

Patron.	Total work performed.		Cash work.			
	Samples or units.		Samples or units.		Pesos.	
	1914	1915	1914	1915	1914	1915
Bureau of Prisons—Continued.						
Rats for plague	10					
Miscellaneous biological work and examinations	61	5				
Total	72,299	27,052				
Bureau of Public Works.						
Metals and alloys	3	3		3		29.00
Coal analyses	1					
Crude chemical and miscellaneous analyses		6				
Cements	1,587	2,014	1,587	2,014	2,306.80	3,257.10
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	22	6	22	6	64.00	24.00
Standardization of road materials	7	5	7	5	87.65	26.00
Paints, varnishes, and linseed oils	4	8	4	8	36.00	94.50
Petroleum and products, copra, and similar materials		3				
Miscellaneous chemical analyses and examinations	1					
Waters:						
Chemical	139	146				
Biological	113	106				
Photographic work		16		16		5.30
Physical tests of wire, twine, fiber, textile, paper, and similar articles		3		3		13.00
Shop work		1		1		18.00
Total	1,877	2,317	1,620	2,056	2,494.45	3,466.90
Bureau of Quarantine Service.						
Urines, clinical and toxicological analyses		1				
Fæces	6,762	1,693				
Sputum		2				
Leprosy	2					
Plague	3					
Rats for plague	39	266				
Vaccine virus	6,350	9,400	6,350	9,400	63.50	94.00
Total	13,156	11,362	6,350	9,400	63.50	94.00

TABLE II.—*Comparative table of routine work, etc.*—Continued

Patron.	Total work performed.		Cash work.			
	Samples or units.		Samples or units.		Pesos.	
	1914	1915	1914	1915	1914	1915
Bureau of Science.						
Metals and alloys	8	20				
Rocks, minerals, natural pigments, and similar substances		15				
Clays, shales, limestones, limes, wall plasters, cements, and slags	5	3				
Coal analyses	2	1				
Calorimetric tests of fuels	1					
Crude chemical and miscellaneous analyses	2	7				
Standard solutions	25	18				
Cements		20				
Petroleum and products, copra, and similar materials	15	2				
Paints, varnishes, and linseed oils		1				
Paper and similar materials	3					
Miscellaneous chemical analyses and examinations		6				
Waters:						
Chemical	9	1				
Biological	399	733				
Assays	8					
Fæces	73					
Rabies	5					
Miscellaneous biological work and examinations	1					
Miscellaneous sera and preparations		1				
Assays		27				
Photographic work	1,822	951				
Shop work	150	162				
Total	2,528	1,968				
Bureau of Supply.						
Metals and alloys	6	1				
Crude chemical and miscellaneous analyses	20					
Standard solutions		1		1		4.00
Physical tests of wire, twine, fibers, textiles, paper, and similar materials	29	10	29	10	82.00	31.00
Cements	4,888	3,788	4,888	3,788	4,190.00	3,522.40

TABLE II.—*Comparative table of routine work, etc.*—Continued

Patron.	Total work performed. Samples or units. 1914	Total work performed. Samples or units. 1915	Cash work. Samples or units. 1914	Cash work. Samples or units. 1915	Cash work. Pesos. 1914	Cash work. Pesos. 1915
Bureau of Supply—Continued.						
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	5		5		8.00	
Standardization of road materials	1		1		15.00	
Standardization of units of measures:						
Lengths	171	60	170	60	88.50	6.00
Capacities	308	121	308	121	88.70	27.10
Weights	751	24	751	24	77.45	14.50
Miscellaneous	28	21	28	21	12.00	10.50
Petroleum and products, copra, and similar materials	3	1				
Paints, varnishes, and linseed oils	17	36	12	33	145.00	172.75
Foods, alcohols, and beverages	45	49				
Medicines and similar articles	4	3				
Miscellaneous chemical analyses and examinations	24	7				
Waters:						
Chemical	8	7				
Biological	12	11				
Miscellaneous biological work and examinations	1					
Mallein	6		6		6.00	
Miscellaneous sera and preparations	60,000	10,064	60,000	10,064	60.00	45.60
Total	66,327	14,204	66,198	14,122	4,772.65	3,833.85
University of the Philippines.						
Standard solutions	2		2		2.00	
Miscellaneous chemical analyses and examinations		1		1		18.34
Fæces	126	21				
Rabies	1					
Plague	18					
Photographic work	480	531	480	531	219.15	122.20
Shop work	7	3	7	3	45.76	24.84
Total	634	556	489	535	266.91	165.38
City of Manila.						
Clays, shales, limestones, limes, wall plasters, cements, and slags	2		2		6.00	
Crude chemical and miscellaneous analyses	7	35	7	35	78.00	43.00
Cements	119	108	119	108	.20	416.35

TABLE II.—*Comparative table of routine work, etc.*—Continued

Patron.	Total work performed.		Cash work.			
	Samples or units.		Samples or units.		Pesos.	
	1914	1915	1914	1915	1914	1915
City of Manila—Continued.						
Standardization of road materials	1		1		15.00	
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc		12		12		11.00
Miscellaneous chemical analyses and examinations	1	7	1	3	10.00	75.00
Waters, biological	627	1,012				
Miscellaneous biological work and examinations	5	4	5	4	68.00	20.00
Mallein	6		6		6.00	
Miscellaneous sera and preparations	189,040	168,532	189,040	168,532	193.00	200.50
Total	189,808	169,710	189,181	168,694	821.20	765.85
Provinces and municipalities.						
Metals and alloys	1		1		48.00	
Crude chemical and miscellaneous analyses	2	6	2	6	14.00	29.50
Cements	38	510	38	510	142.50	668.00
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	11	60	11	60	53.00	403.40
Standardization of road materials	6	60	6	60	52.50	403.40
Medicines and similar articles	1		1		10.00	
Waters:						
Chemical	1		1		40.00	
Biological	1		1		40.00	
Vaccine virus	65,250	30,000	65,250	30,000	3,077.50	900.00
Photographic work	37	198	37	198	27.20	66.75
Paints, varnishes, and linseed oils		2		2		31.00
Total	65,348	30,836	65,348	30,836	3,504.70	2,502.05
United States Army and Navy.						
Metals and alloys	3	4	3	4	80.00	40.00
Coal analyses	11	43	11	43	151.00	293.40
Colorimetric tests of fuels	3	23	3	23	60.00	352.00
Waters:						
Chemical	1	1	1	1	40.00	40.00
Biological		2		2		80.00
Physical tests of wire, twine, fibers, textiles, paper, and similar articles		8		8		12.00
Cements	126	61	126	61	308.60	328.50

TABLE II.—*Comparative table of routine work, etc.*—Continued

Patron.	Total work performed.		Cash work.			
	Samples or units.		Samples or units.		Pesos.	
	1914	1915	1914	1915	1914	1915
United States Army and Navy—Continued.						
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc		13		13		22.00
Crude chemical and miscellaneous analyses		1		1		5.00
Urines, clinical and toxicological analyses	2		2		50.00	
Standardization of units of measures		1		1		5.00
Petroleum and products, copra, and similar materials	1	1	1	1	16.00	15.00
Paints, varnishes, and linseed oils	14	2	14	2	108.00	30.00
Foods, alcohols, and beverages	11	6	7	6	96.00	78.00
Vaccine virus	22,172	18,330	22,172	18,330	717.80	588.50
Mallein	328	10	328	10	328.00	10.00
Miscellaneous sera and preparations	528,831	767,744	528,831	767,744	2,184.35	1,763.80
Shop work	1		1		5.18	
Total	551,504	786,250	551,500	786,250	4,144.33	3,663.20
Miscellaneous.						
Metals and alloys	28	11	28	11	308.50	174.00
Clays, shales, limestones, limes, wall plasters, cements, and slags	3	2	3	2	21.00	28.00
Fertilizers	12	22	12	22	132.00	246.20
Soils and similar substances	30		30		693.00	
Coal analyses	8	6	8	6	125.00	92.00
Calorimetric tests of fuels	3	11	3	11	60.00	320.00
Crude chemical and miscellaneous analyses	49	73	49	73	197.50	419.50
Physical tests of wire, twine, fibers, textiles, paper, and similar articles		10		10		27.00
Standard solutions	3		3		27.00	
Cements	59	215	59	215	248.70	1,234.80
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	48	112	48	112	205.00	175.00
Standardization of road materials		6		6		38.00
Standardization of units of measures:						
Capacities	4		4		10.70	
Miscellaneous	13		13		42.00	

TABLE II.—*Comparative table of routine work, etc.*—Continued

Patron.	Total work performed.		Cash work.			
	Samples or units.		Samples or units.		Pesos.	
	1914	1915	1914	1915	1914	1915
Miscellaneous—Continued.						
Urines, clinical and toxicological analyses	63	82	63	79	199.00	254.00
Essential oils and essences	13	11	13	11	89.50	77.50
Petroleum and products, copra, and similar materials	10	9	10	9	73.50	83.00
Paints, varnishes, and linseed oils	4	8	3	8	30.00	80.40
Gums, resins, and similar materials		1		1		5.00
Gastric juice, clinical examinations	3		3		15.00	
Foods, alcohols, and beverages	251	239	249	239	788.00	873.20
Food preservatives and coloring matters	2	15	2	15	4.00	89.00
Medicines and similar articles	2	10	2	10	45.00	345.00
Miscellaneous chemical analyses and examinations	23	32	23	32	90.00	204.70
Assays	403	650	403	650	653.45	957.76
Waters:						
Chemical	13	31	13	31	285.00	571.50
Biological	7	9	7	9	280.00	270.00
Fæces	346	1,118	346	1,118	1,129.00	3,352.33
Sputum	30	21	30	21	90.00	63.00
Blood	6	20	6	20	18.00	60.00
Blood culture	2	2	2	2	10.00	10.00
Widal test	5	6	5	6	21.00	18.00
Wassermann test	288	257	288	257	2,880.00	2,502.88
Leprosy	3		3		9.00	
Urines	2	1	2	1	5.00	25.00
Gonococci	24	10	24	10	72.00	30.00
Histological examinations	8	13	8	13	80.00	130.00
Miscellaneous biological work and examinations	46	5	46	5	297.00	28.00
Vaccine virus	2,613	1,726	2,613	1,726	124.75	102.00
Mallein	175		175		175.50	
Miscellaneous sera and preparations	789,932	726,764	789,932	726,764	1,926.90	2,502.88
Photographic work	9,496	2,247	9,496	2,247	2,558.35	736.09
Natural-history specimens	8	82	8	82	81.24	208.48
Shop work	17	15	17	15	550.97	83.82
Miscellaneous work	52	17	52	17	8,081.52	5,249.94
Sales of publications					3,433.16	4,548.99
Refunded, work not done, etc. (deducted)					(82.75)	(102.50)
Power, gas, etc					31,995.70	31,125.23
Total	804,107	733,869	804,104	733,866	58,079.19	57,239.70
Grand total	9,599,277.33	7,180,625	9,320,399.33	7,011,863	114,738.45	98,197.62

TABLE III.—*Comparative statement showing expenditures and income during the fiscal year 1915 (January 1 to December 31, 1915) as compared with the fiscal year 1914.*

EXPENDITURES.

Item.	Fiscal year 1914.	Fiscal year 1915.
Salaries and wages, etc.:	*Pesos.*	*Pesos.*
Salaries and wages, including accrued leave	224, 113. 73	191, 349. 75
Traveling expenses of personnel	14, 212. 98	12, 026. 16
Total	238, 326. 71	203, 375. 91
Apparatus, supplies, etc.:		
Consumption of supplies and materials, including subscriptions	74, 407. 70	73, 156. 96
Apparatus and equipment, including books	25, 450. 77	14, 448. 88
Total	99, 858. 47	87, 605. 84
Miscellaneous:		
Rental of buildings	720. 00	682. 50
Postal, telegraph, telephone, and cable service	4, 932. 12	4, 764. 62
Freight, express, and delivery service	980. 09	1, 176. 32
Printing and binding reports, documents, and publications	28, 695. 67	33, 590. 61
Illumination and power service	402. 53	1, 647. 02
Contingent service	3, 631. 71	3, 079. 95
Maintenance and repair of furniture and equipment	712. 92	4, 409. 75
Total	40, 075. 04	49, 350. 77
Grand total	378, 260. 22	340, 332. 52

INCOME.

	Pesos.	*Pesos.*
Receipts from operation	115, 486. 73	98, 197. 62
Prior year income	(838. 20)	2, 665. 88
Sales of supplies	488. 82	. 73
Sales of fixed assets	2, 716. 45	25, 889. 93
Total	117, 853. 80	126, 754. 16

MISCELLANEOUS ACCOUNTS (1915).

Item.	Available.	Expended.	Balance.
	Pesos.	*Pesos.*	*Pesos.*
Tiqui-tique distribution, Act No. 2376	5, 056. 64	1, 524. 00	3, 532. 64
Improvement of the Aquarium, Act No. 2494	2, 000. 00		2, 000. 00
Replacement fund	1, 344. 21	1, 344. 21	
Public Works: Alterations to boiler, Act No. 1989	794. 00	794. 00	
Library equipment, Act No. 1988	1, 572. 57	1, 572. 57	
Total	10, 767. 42	5, 234. 78	5, 532. 64

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Order No. 412. Price $1.25 United States currency, postpaid.

A FLORA OF MANILA. By E. D. Merrill.
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FIFTEENTH ANNUAL REPORT OF THE DIRECTOR OF THE BUREAU OF SCIENCE

PHILIPPINE ISLANDS

TO THE HONORABLE
THE SECRETARY OF THE INTERIOR

BY

ALVIN J. COX
DIRECTOR OF THE BUREAU OF SCIENCE

FOR THE YEAR ENDING
DECEMBER 31, 1916

MANILA
BUREAU OF PRINTING
1917

FIFTEENTH ANNUAL REPORT OF THE DIRECTOR OF THE BUREAU OF SCIENCE

THE GOVERNMENT OF THE PHILIPPINE ISLANDS,
DEPARTMENT OF THE INTERIOR,
BUREAU OF SCIENCE,
Manila, January 1, 1917.

SIR: I have the honor to submit the following general statement of the activities of the Bureau of Science from January 1, 1916, to December 31, 1916.

During the year the Director and his staff have been in demand by manufacturers, teachers, contractors, Army and Navy officials, sanitarians, practitioners, dairymen, sugar growers and other agriculturists, geologists, engineers, metallurgists, wholesale druggists, mining and dredging operators, consuls, merchants, and others for information on a great variety of subjects. Besides hundreds of interviews I have received many inquiries by mail, which the following will serve to illustrate:

MANILA, *November 27, 1916.*

Dr. ALVIN J. COX,
Bureau of Science.

DEAR SIR: Enclosed please find check for $75 as requested. You will kindly get the following paper pulp materials for me—A bale of Talahib grass, a bale of Cogon grass and one bale of Nipa Palm, each weighing 300 pounds. In the woods, I would like a log about 10 or 12 inches in diameter 3 feet long of the following. Cupang, Talisay, Palosapis, Teluto, and Laoan. * * * Will call at your Bureau Tuesday p. m. Thanking you for your early attention to the above—and for other favors,

I remain, yours truly,

MANILA, *November 21, 1916.*

We have an inquiry for Soya Oil from one of our friends abroad. We should like to be advised whether this is produced in the Philippine Islands.

Yours very truly,

MANILA, *November 12, 1916.*

* * * At one time a circular was issued by the Bureau in which it had a sample of paper made from cogon so it might be that you have some information that will be a help to me along a line that has been bothering me for some time. The hemp waste from the knives makes good paper but on our places it is going to fertilize the ground only. What dope can you furnish me along the following?

(*a*) Is it possible to prepare paper pulp in a small way commercially? (*b*) What is the best way of preparing pulp from hemp waste for market? (*c*) Will paper makers buy a semicompleted pulp? (*d*) What is the price per pound approximately? (*e*) What is the price of pulp such that it would justify shipping to the states under the present freight rate? (*f*) If the price is sufficient what is the approximate cost of installing the smallest plant which can be run economically and where could plans and specifications for the same be procured?

In the matter of supervision, no extra expense need be counted in as I already have my work arranged so a line like this would not increase my overhead expenses. * * *

Very sincerely,

MANILA, *October 13, 1916.*

We have been informed that your Bureau has by a chemical examination classified the various qualities of Philippine Gum Copal, regularly being exported to the United States of America. We would be very thankful to you if you could let us have samples showing the different grades as classified by your Bureau. * * *

Yours very respectfully,

MANILA, *October 2, 1916.*

We refer to our recent conversation relative to exporters of crude botanical drugs, and, in accordance with same, are taking advantage of your suggestion by enclosing you herewith copy of letter from the manager of our Foreign Trade Information Bureau.

"Our friends, the above, importers of crude botanical drugs, wish to get in direct touch with foreign houses making these lines for export, and to receive quotations from such houses with regard to developing direct business."

We would much appreciate it if you would communicate direct * * * dealing with the inquiry referred to * * *. We would very much appreciate it if you could see your way clear to favor us with a copy of your letter.

Yours very truly,

BOSTON, MASSACHUSETTS, *September 19, 1916.*

It has come to our attention that you are in position to give us information regarding the price and availability of Lumbang Oil. Kindly send us such information as you may have regarding the use, preparation and adaptability of this oil, explaining the details of the probability of its import in this country.

Yours truly,

ZAMBOANGA, *September 19, 1916.*

* * * I write to you for the information on silkworms, mosquitos, flies, or other insects, coal, gold, or other minerals, birds, fish, fish farms, names of plants, fungous diseases of plants, plant physiology, flowers from which perfumery is secured, different kind of soil, sugar, cholera, smallpox, tuberculosis, bacteria etc.

Thanking you in advance, I remain, sincerely,

SINGAPORE, *September 16, 1916.*

I am in receipt of your letter of August 18th, and have also received a small sample of rubber which you sent me, and I thank you for your attention to the matter.

The size of the sample which you sent me, precludes the possibility of making anything more than a small laboratory test, but from what you

say as to the quantities of the vine producing this rubber, I should think there would be no difficulty in getting together a shipment of say, 50 or a 100 pounds, for which I will very gladly pay. If I can get this quantity, I will be in a position to make some local tests, and can also send enough of the rubber home for our factory to test and to make up into manufactured goods, which in their turn will also be tested. The result of such a test, of course, will be very conclusive, and we would be in a position to place a definite value on this rubber. * * *

Yours truly,

DORKING, ENGLAND, *September 6, 1916*.

I believe that Datura Alba—a species of Stramonium or Thorne Apple—grows plentifully in your Islands. I am interested in the herb as a source of Atropine and wonder if you could have sufficient sent to me (about 2 kilograms or 3 pounds) to estimate the value of the herb, I should also like some seeds if they can be obtained in sufficient quantity.

I am, sir, yours obediently,

BRISBANE, QUEENSLAND, AUSTRALIA, *September 5, 1916*.

We have felt for some time that something might be done in Queensland waters to improve the class of sponges on the Barrier Reef, and I am wondering whether it would be practicable to introduce a number of good marketable sponges into Queensland waters, with a view to obtain all possible information on this subject, I am writing to ask whether you could assist us in the matter, and perhaps put us in direct communication with those most able to help us.

In the meanwhile properly identified specimens of such sponges are keenly desired.

Soliciting the kind favour of your reply, I am, yours sincerely,

MANILA, *July 31, 1916*.

I have received a letter inquiring the whereabouts of a large deposit of short fibre asbestos reported to have been found in these islands. * * *

I notice in the interesting booklet on the Industrial Resources of the Philippine Islands published by your Bureau about two years ago that asbestiform minerals occur in many localities.

I shall be much obliged if you will kindly give me any information with regard to this deposit, which was reported through an American channel, or if any others that are being worked, giving the names and addresses of the parties controlling them.

The inquiry comes from a business house stated to be a large buyer of this material.

I have the honour to be, sir, your obedient servant,

SYDNEY, *July 26, 1916*.

We understand that you have particulars of a patent process for extracting the oil from the matured coconut as it is gathered off the tree, instead of the usual process of first drying the nut into copra, and then pressing for the oil.

As we are large crushers of coconut oil and are interested in considerable plantations in the Pacific, we would be very pleased if you could favor us with full particulars of this process and any data which you think would be of any service to us.

We thank you in prospect.

Yours faithfully,

NEW YORK, *July 17, 1916.*

In one of last year's Commerce Reports, Washington, we have read an article regarding a new *Philippine Oil Nut,* the botanical name of which is "*Chisochiton cumingianus*" (Harms). * * *

This little nut contains about 45 per cent of a dark, fatty, nondrying oil that makes very good soap. We would kindly ask you to let us have a full description of the trees and the nuts, also what is the area covered by same. Also what is the commercial value of these nuts and if there are any means of exporting same from the Philippine Islands.

Any information which you could give us on the matter would be greatly appreciated, as we intend to import this nut into this market in large quantities.

Yours respectfully,

MANILA, *July 5, 1916.*

* * * We shall appreciate greatly any information that you can furnish us in reference to Almaciga in the Philippines.

We are considering the exportation of this gum to the United States and are interested in data of any character whatsoever.

Thanking you in advance, we beg to remain, yours very truly,

SAN FRANCISCO, CALIFORNIA, *June 23, 1916.*

The Bureau of Fisheries, Washington, D. C., has referred us to you for information, which we seek regarding commercial fish products obtainable in Philippine waters.

The information we desire is principally as to the presence of commercial "sardines" said to be very abundant in Manila Bay, during season. * * *

[Inquiry for authentic information concerning size and species of sardines, labor, prices of olive, soya bean and coconut oils, salt, building materials, etc.]

* * * Being in the fish-food and fertilizer business and having heard considerable talk about the presence of sardines in Manila Bay this Company would consider the establishment of such enterprise in the Philippines, providing the conditions are favorable.

If you will give us such information as you may have on this subject * * * we shall feel very much obliged to you.

Yours very truly,

SAN FRANCISCO, CALIFORNIA, *June 19, 1916.*

We have had an inquiry for the following minerals and would ask that you please inform us whether the same can be obtained in the Philippines.

"Mineral Ore of a Hematite base running 50 per cent or over Fe_2O_3. Or Hydrated Oxide of Iron of red shade containing either Calcium Alumina or Silicious impurities not over 50 per cent."

If these minerals can be obtained we would be in the market for large quantities of same.

Hoping to receive your immediate reply and thanking you in advance, we are,

Yours respectfully,

SAN FRANCISCO, CALIFORNIA, *May 26, 1916.*

We have received an inquiry from our San Francisco friends regarding a source of supply in the Philippines for crude sulphur. We would like to

have you advise us if there are any sulphur mines being worked here and if same could be obtained in sufficient quantities for export. * * *

Thanking you in advance for your trouble in this matter.

Yours very truly,

MANILA, *May 9, 1916.*

Respectfully referred to the Director of the Bureau of Science, requesting such information as he may be able to furnish regarding the commercial possibilities of Gulaman, a substitute for gelatine.

SECRETARY TO THE GOVERNOR-GENERAL.

WASHINGTON, D. C., *May 6, 1916.*

* * * request information with regard to the production of pearl shell in the Philippines, particularly the reported discovery of new beds in the neighborhood of Polillo Island and of various parts of the Visayas, and the method of marketing. They also desire references to any material published on the subject within the last six or seven years. * * *

Very truly yours,

NEW YORK, *May 1, 1916.*

* * * We are manufacturers of glue and therefore users of "Waste parts sold for manufacture of glue" * * *. Can you inform us how we can get in touch with the tanneries producing this glue stock in the Philippines?

Very respectfully,

MANILA, *April 12, 1916.*

Can you tell me of any local dye materials which the natives might be induced to gather, not in export quantities but in comparatively small amounts? Information regarding the kind, location, approximate quantity, and method of obtaining any sort of dye material will be very much appreciated.

Very truly yours,

MANILA, *March 20, 1916.*

We are in receipt of the following communication: "There are unlimited areas of mangrove swamp in the Philippines. Is there any prospect of securing the extract or the bark in commercial quantities, at a price that will permit business?" We shall greatly appreciate your information if it is possible to secure this extract and if it is suitable for tanning purposes.

Thanking you in advance for your trouble in this matter, we beg to remain, sir,

Yours very truly,

CEBU, P. I., *March 10, 1916.*

If you will favor me with information regarding coconut milk or "water;" its value in coagulating rubber as recently discovered, etc., I shall greatly appreciate the courtesy.

Thanking you in anticipation of your esteemed reply,

Believe me, yours sincerely,

NEW YORK, *March 10, 1916.*

We * * * would respectfully enquire if you can furnish us with any information regarding a new oil nut, known as "Chisochiton Cumingianus." * * *

Yours very truly,

All of these inquiries have been replied to at length, and the appreciation of the recipients is indicated by the following selected replies:

SINGAPORE, *December 24, 1916.*

Dr. ALVIN J. COX,
Director, Bureau of Science, Manila, P. I.

MY DEAR DOCTOR COX: * * * I have visited scientific institutions in the Orient, to which people pointed with conscious pride. I was astonished at what was not done, as I had regarded it as a matter of course, and now feel that the scientific methods of the Bureau of Science are largely due to your own administrative methods, as even that institution would not run by its momentum after Dr. Freer's death.

Your work in the application of scientific methods to industry, as in tanning, copra drying, and many others, stands alone. I find that the heads of departments have been trying in vain for years to get things of that kind accomplished, but with little success. The Journal of Science is constantly quoted with respect. The Bureau of Science seems unique in the Orient. * * *

With best regards, yours very sincerely,

SANDUSKY, OHIO, *December 7, 1916.*

I beg to acknowledge your valued letter of December 6 instant and thank you for the same.

I want to say further that in all my travel and investigations throughout the world I have never found any government department and its officials and clerks so willing to give information and aid as your department has done and that it really has been a matter of surprise to me.

I wish to say further that there is no doubt in my mind that with the material and data that you have furnished me our Board of Directors will be doubly interested toward their aim of establishing a factory here for our trade in the Orient.

Yours very faithfully,

MANILA, *December 1, 1916.*

I beg to acknowledge, with thanks, receipt of twelve press bulletins of the Bureau of Science, as well as of one copy of each of the annual reports for the years 1914 and 1915. I also beg to thank you most sincerely for your kind courtesy in granting me admission to the library of your Bureau.

It will be of great help and utility to me to receive regularly the copies of the press bulletins whenever they are issued, as well as any other report or information you may care to give me from time to time.

I am, yours respectfully,

HONGKONG, *November 4, 1916.*

* * * The Bureau of Science seems to be the only organ in the Filippines that has any international reputation; this has been established principally through the "Journal of Science". * * *

I have been making studies into economic conditions, and have found the comparisons with what has been accomplished in the Filippines most instructive. I have found nothing like the work which the Bureau of Science has been doing under you to make the discoveries of science

practically useful to the country, and hope that your efforts are appreciated. * * *

With kind regards, yours very sincerely,

NABUA, AMBOS CAMARINES, *October 31, 1916.*

RESOLUTION NO. 141.

By a motion of Concejal Francisco Gimenes seconded by Concejal Vicente G. Uvero,

Be it resolved by the Council, that the Bureau of Science (Manila) be asked to send to this municipality one thousand copies of Bulletin No. 57 for distribution among the inhabitants of this municipality who are devoted to the growing of sugar cane. A copy of this resolution is being sent to the said Bureau of Science for this purpose.

Unanimously approved.

I certify: That the foregoing resolution is a true copy.

MUNICIPAL SECRETARY,[1]
Nabua, Ambos Camarines.

MANILA, *October 16, 1916.*

Please accept thanks for yours of October 12th, with copy of your letter of the same date to S. B. Penick & Co., New York City, which we feel confident will produce results, if the firm in question is actually interested in the importation of botanical drugs from this market, which we have every reason to believe is the case.

Yours very truly,

SAN JUAN DEL MONTE, *October 11, 1916.*

Some weeks ago, as you know, we were having trouble with our water after it was put into the demijohns, and we came to the conclusion that something was wrong with our system of sterilizing the demijohns, for our tests of water taken directly from the pipes connected with the well showed that the water from the well was absolutely pure and sterile.

I then, as you know, came to see you to get your assistance in devising some scheme of sterilization that would be effectual, and I am pleased to state that the system developed for us by the Bureau of Science is now in successful operation, making it possible for us to deliver water that comes away within the safety limits, and, as is shown by the various severe tests that have been made, so long as we do not fail to put each and every demijohn through the system properly, we are sure that the water taken from any demijohn we deliver will show safe.

For this highly desirable, and in fact, absolutely essential result, I feel that this company and the public it serves should extend to you and your assistants their sincere thanks.

Please accept this letter as expressing the gratitude of this company, and I am sure that when the public realize what has been done for them, you will have their thanks as well.

Very sincerely yours,

CLEVELAND, OHIO, *September 29, 1916.*

We have your favor of August 19 and wish to thank you for the information you have included in your favor mentioned above, also the publication which you inclosed. This information is very desirable and very interesting. We are now making some experiments with lumbang oil in a

[1] Translated from the Spanish.

limited way and the writer will be very glad to reciprocate and a little later advise you the results of the tests we are now making here.

Thanking you again for your interest, we remain,

Yours very truly,

ZAMBOANGA, *September 23, 1916.*

I beg to acknowledge with thanks the receipt of copy of the Bureau of Science Bulletin No. 54 which you were kind enough to furnish this office. This bulletin contains very valuable information for the development of agriculture and industry in these islands. Please accept my congratulations for the successful completion of this important work.

Please have furnished us with fourteen additional copies both in English and Spanish of said bulletin for distribution among our provincial governors of this department.

Thanking you for this and past favors, I remain,

Very respectfully,

SAN CARLOS, NEGROS, *September 19, 1916.*

We duly received your letter of September 12, 1916, with enclosed blueprint of your new lime kiln, for which please accept our thanks.

No doubt this kiln will prove to be a very satisfactory type and we shall be much interested in the result of a trial which, we hope, will take place in the near future.

Thanking you again for your kindness in regard to this matter, we are,

Very respectfully,

SANTA CRUZ, LAGUNA, *September 8, 1916.*

I have been interested in having my attention called to Bulletin No. 54, issued by the Bureau of Science, as posted in typewritten form here in Santa Cruz. This is, I am sure, a most valuable collection of practical information which should be spread as widely as possible. With this in view I am desirous of securing copies of this Bulletin in English and Spanish, as I have considerable opportunity of bringing these things to the attention of many of the common people.

I shall be obliged if you will kindly send to me copies of the bulletin referred to.

Respectfully yours,

CADIZ, OCCIDENTAL NEGROS, *September 2, 1916.*

Last week Mr. J. F. Armstrong, an employee of the Bureau of Science was here in Cadiz. This kind gentleman came to us hacenderos of this district and gave us news which during these many years was unknown to us. He has given us wise instruction in the milling of the sugar cane and the methods of manufacturing muscavado in a scientific way notwithstanding the antique methods which we still use.

We, the hacenderos of Cadiz, are as yet ignorant of the methods used by those of Silay, Saravia, and other sugar-producing towns, but as progressive men we are anxious to know said methods; how to obtain a good extraction of juice from the cane, to skim the juice, how to lime properly, and to obtain a good quality of sugar. * * *

All these paying methods were clearly explained to us by Mr. J. F. Armstrong during his short visit in this section, and we are convinced that it would give us very satisfactory results. * * *

For all the reasons herein mentioned, I take the liberty to suggest that Mr. J. F. Armstrong, or someone else employed in the Bureau of Science, give lectures and travel all over the sugar districts of the Philippines to

instruct the farmers, so that they, little by little, may discard the old methods which they now use to produce a poor grade of sugar, while those who know say that the soil of the Philippines and particularly the soil of this Province is exceptionally adapted for sugar cane.

Yours very respectfully,[1]

SILAY, *August 28, 1916.*

In behalf of the hacenderos of Silay and Saravia, Negros Occidental, I wish to thank the Bureau of Science for services rendered to the farmers of these towns by Mr. Armstrong, of the Iloilo office of the Bureau of Science, in helping them sign a contract for a sugar central. Mr. Armstrong has done a great deal toward bringing a better understanding of the advantages of a central sugar factory to produce centrifugal sugar over the present system of manufacture of sugar in vogue in this Island; he has explained to the farmers the mode of operation of a modern sugar mill and in every way has helped the farmers of this district to improve their ideas regarding the milling and manufacture of sugar.

Yours very truly,[1]

SAN MATEO, RIZAL, *August 8, 1916.*

RESOLUTION NO. 66.

The President submitted the following resolution:

It is resolved: To request the Director of the Bureau of Science, Dr. Alvin J. Cox, to furnish to the municipality of San Mateo, Province of Rizal, for its file, the result of the analysis of waters of San Mateo.

It is further resolved: To congratulate the Director of the Bureau of Science, Dr. Alvin J. Cox, on his meritorious work of analyzing said waters with no other object than the good of the inhabitants of these Islands.

Unanimously approved.

I certify that the foregoing resolution is faithfully transcribed.

MUNICIPAL SECRETARY.[1]

HONOLULU, H. I., *July 28, 1916.*

On behalf of the Board of Commissioners of Agriculture and Forestry I wish to thank you for the assistance which you so kindly rendered to our Field Entomologist, Mr. D. T. Fullaway, while he was in Manila on his way back from India, breeding parasites for introduction into these islands. Your kindness in furnishing him with a room with laboratory facilities, materials, and labor assistance in building cages, helped greatly to make Mr. Fullaway's mission successful.

You may be glad to know that he reached here with the parasites in good condition, and has been able to multiply and distribute them among the islands with good results.

Very truly yours,

MANILA, P. I., *July 18, 1916.*

Many thanks for yours of the 15th instant received this morning, covering looms. The information is just what I wish * * *

Sincerely,

MANILA, P. I., *July 15, 1916.*

Kindly accept our many thanks for communications referred to us on the 1st inst., in reference to asbestos.

Very respectfully,

[1] Translated from the Spanish.

TAIHOKU, JAPAN, *June 27, 1916.*

We feel it our duty to express our deepest thanks to you for the courtesy extended to Mr. Kosaku Ebiku, our expert, on the occasion of his visit to Manila on official mission. He has safely returned to Taipeh with pleasant reminiscences of his travel in the Philippine Islands, and it is highly gratifying to state that he had found his visit to Manila, where he was received by your good self in such a cordial manner, particularly interesting and delightful, which is without question due to the valuable aids you rendered him, and of which he speaks in very appreciative terms.

We sincerely hope that his visit to Philippines may, in future, contribute something towards the promotion of mutual interest and better understanding between the two colonies.

With highest regards and respect, we have the honour to be, sir,

Your obedient servants,

LA CARLOTA, NEGROS OCCIDENTAL, *June 10, 1916.*

Though not having the honor of knowing you, I take the liberty to express my gratitude to you and to your Bureau on account of the great interest shown in sugar work by Messrs. Thurlow and Armstrong, employees of your Iloilo office, who have brought the necessary apparatus and have analyzed sugar cane juice, bagasse, and sugar cane. * * *

Messrs. Armstrong and Thurlow have also been in various "haciendas" in this section for the same object. They have discussed with the "hacenderos" and have imbued in them the new ways and have helped them in all matters pertaining to agriculture. Their interest is such that they have even traveled at night with danger to their health, due to the rains that we had this year.

Expressing again my sincerest thanks and gratitude to you, I am,

Very respectfully,[1]

MANILA, *June 9, 1916.*

I have to acknowledge, with thanks, the receipt of your letter of May 10, and appreciate very much your kindness in offering your assistance to the Philippine Trade Review, in extending the profitable relations between the Philippine Islands, the United States and foreign countries, also for placing our name on the list to receive the various publications issued by your Bureau. * * *

Very respectfully,

SYDNEY, N. S. W., AUSTRALIA, *8th June, 1916.*

I am instructed by the Director General of Public Health to acknowledge with thanks receipt of your letter of the 11th ultimo in regard to the destruction of flies by certain species of ants, and to say that the information furnished by you is greatly appreciated.

Your obedient servant,

MALITA, DAVAO, *May 30, 1916.*

Many thanks indeed for your letter of April 13, as it contained some information which will be of quite a little use to me. * * *

I am not in a position to give the time necessary to work out a paper pulp factory just at present but when I come to Manila during the latter part of the year I would like to call on you for all the information that you may have that will help me to utilize that small amount of waste that

[1] Translated from the Spanish.

occurs on a plantation the size of mine. I cannot afford to erect a large factory to handle what there is here but there should be enough stuff here to make 500 pounds of pulp a day, and that is what I want. * * *

Very sincerely,

PHILADELPHIA, *May 9, 1916.*

Many thanks for the lately received copy of your highly interesting and valuable Thirteenth Annual Report, which I have perused with lively attention and much pleasure and profit. The amount of routine work your Bureau has accomplished is amazing, without altogether neglecting more attractive research work. * * *

Heartily wishing you continued success in your enterprises, I am always,

Very truly yours,

MANILA, P. I., *19th April 1916.*

We beg to acknowledge the receipt of your communication of the 12th inst. and are very much obliged to you for the valuable information it contains concerning tanning barks.

We trust we shall soon have an opportunity to reciprocate, and remain,

Yours very truly,

MANILA, P. I., *April 13, 1916.*

Some months ago you were kind enough to send us your formula for rendering cloth bindings vermin-proof. This formula was sent on to our main office in Rochester, New York, with a view to replacing a formula which we had not found entirely satisfactory.

We are just in receipt of a letter from the Home Office advising that your formula has been treated and found satisfactory and that from this time on, they will discontinue the use of sheep in binding our reports and will use our regular buckram treated with your formula. Heretofore, we have been compelled to supply sheep bindings in districts where our buckram would not stand the ravages of the insects.

The Home Office states further that they are sending an advice to all our subscribers throughout the United States, their possessions and foreign countries, informing them of the change of binding and that it is due to the success of a formula perfected by the Bureau of Science of the Insular Government of the Philippines. Undoubtedly, this will be of interest to you.

With thanks for your great service, we remain,

Yours very truly,

POLO, BULACAN, *April 2, 1916.*

I have the honor to inform you that the result of the formula furnished free by that Bureau for bleaching to me has been successful. Allow me to express my sincere gratitude to you for this great favor. [Here follows the formula.] Those solutions are good for 100 hats.

Very respectfully,

COMPOSITOR DE SOMBREROS.

LA CARLOTA, NEGROS OCCIDENTAL, *March 29, 1916.*

I have the honor to advise you that Mr. J. E. Armstrong, sugar expert of your Bureau, has been performing very useful work in my "hacienda," where I have a modern mill equipped with vacuum pans, centrifugal pumps, etc. As the handling of these apparatus and the modern process of extracting sugar cane juice are new in this country, * * * during his

short stay he has demonstrated practical experiments which I believe will be of incalculable value to me in the future. * * *

Yours very respectfully,[1]

MANILA, *March 21, 1916.*

In connection with our letter of July 12, 1912, requesting a compound for re-inking planotype ribbons and formula submitted in your letter of August 26, 1912, I wish to advise you of the results of this work.

One-quarter bottle of the solution was purchased at a cost of ₱5.88 which was sufficient for re-inking six of the ribbons. It will be noted therefore that the cost per ribbon is ₱0.96—slightly over 10 centavos per meter—for re-inking, exclusive of labor which is a negligible item in view of the fact that the messengers were employed for the work during otherwise spare time. New ribbons cost ₱2.63 each for the cheapest grade employed and ₱3.94 for a more expensive grade. The fabric, after being used thoroughly is not damaged and the re-inking has been done with success. The ribbons were finally dried after re-inking and are fully as satisfactory for ordinary use as are the original purchases.

This information may be of interest to you.

Very respectfuly,

HONGKONG, *March 13, 1916.*

We beg to acknowledge receipt of your letter dated the 7th instant, contents of which are noted with thanks.

We have passed your information relative to Beriberi to our friends, whom we feel sure will appreciate the trouble you have taken so kindly in this matter.

We are, dear sir, yours faithfully,

MATABANG, TALISAY, OCCIDENTAL NEGROS, *March 3, 1916.*

Mr. Armstrong, of your Iloilo office, spent the day with me on my hacienda on his way to Isabela. He made several analyses of cane and sugar which benefited me and I am pleased to say that I appreciated his services.

I hope that you will allow him to come back again when convenient. We have several haciendas and need occasionally a look-over of a good practical man like Mr. Armstrong.

Thanking you, I am, yours truly,

BAGUIO, BENGUET, P. I., *February 26, 1916.*

We have a good deposit of silica that we should like to find a market for or a use for. * * *

You may be interested in knowing that the samples of hydrated lime you recently analyzed for us brought us a Manila order for 400 tons.

Thanking you for any information you may have re silica, we are,

Yours very truly,

MANILA, *February 25, 1916.*

We returned from Mindoro yesterday on the *Malecon.* I wish to thank you for the trouble you have gone to on my behalf, in helping me with my transportation difficulties. Had it not been for your timely assistance I would have experienced great trouble and delay in obtaining a steamer suitable for my work.

Please accept my appreciation of your policy of fostering the develop-

[1] Translated from the Spanish.

ment of the latent resources of the Islands. Kindly let me know what I owe the Bureau of Science over the credit which I now have with your department.

Yours very truly,

MANILA, *January 26, 1916*.

Allow me by these presents to tender you my sincerest thanks on behalf of "La Nacional Guano Factory," for the scientific services you have rendered us, through your valuable assistance of plant analysis, as received by us on the 18th inst.

Your tables are indeed interesting, and will help us materially in manufacturing a standard fertilizer suitable for these islands.

We are sir, very respectfully,

FAR EASTERN ASSOCIATION OF TROPICAL MEDICINE

The Fifth Biennial Congress of the Far Eastern Association of Tropical Medicine was to have been held in Java during the year, but the arrangements were canceled because of the European war.

PHILIPPINE ISLANDS MEDICAL ASSOCIATION

No meeting of the Philippine Islands Medical Association was held in 1916.

CONGRESS OF PHYSICIANS AND PHARMACISTS

The third congress of physicians and pharmacists was held in Manila under the auspices of the Colegio Medico-Farmaceutico of the Philippine Islands from the 7th to the 11th of February, 1916, inclusive. The congress was in every way a success, and employees of the Bureau of Science presented 17 papers on various subjects associated with or related to medicine or pharmacy.

STANDARDIZATION OF SUPPLIES

On March 28, 1916, His Excellency the Governor-General issued Executive Order No. 21, appointing "a permanent committee to be known as the Committee on Standardization of Supplies." The committee has held a number of meetings and, in accordance with the provisions of the Executive Order, has secured from Government officials reports and such other information as are essential to carry on its work. The available information is now being used to eliminate inferior material and to effect economy in the purchase of general supplies. The Bureau of Science is carrying on tests to classify many articles of wide variations, so that they may be purchased under specifications with the least cost. It will take a long time to standardize the thousands of articles needed by the Government. The war in Europe has interfered with many of our sources of

supply, and many conditions are abnormal. The work will be pushed as rapidly as possible.

MANUFACTURE OF TIQUI-TIQUI EXTRACT

Under the provisions of Act No. 2376 the Bureau of Science has continued its work of preparing extract of tiqui-tiqui for the treatment of infantile beriberi. A stock has been continually kept on hand, and that prepared up to the close of the year was probably sufficient to treat nearly 6,000 infants. The Liga Nacional Filipina para la Proteccion de la Primera Infancia submitted its report on October 15, 1916, from which I quote the following:

During this year the extract prepared by the Bureau of Science has kept in much better condition than that prepared during the preceding year. The organoleptic character of the extract and its keeping qualities could not have been improved. * * * From October 16, 1915, to October 15, 1916, 4,967 fifty cc. bottles of extract and 39 one cc. ampuls for hypodermic use have been obtained from the Bureau of Science, that is, 1,193 bottles more than that obtained last year. * * *

In the acute forms the mortality during this year has been only 85.7 per cent due to the injection of the extract, instead of 100 per cent as heretofore. * * *

Theoretically no children suffering from beriberi that are treated in time with a sufficient dose of extract of tiqui-tiqui should die. As a matter of fact, our mortality does not reach 1.5 per cent and even this small percentage of mortality is due to the fact that the little patients do not reach us until it is too late, almost at the dying stage, when the medicine has no time to exert its beneficial influence.

Nevertheless, if we review the statistics of the Philippine Health Service, it would be observed that in spite of our work the mortality among children under one year of age due to beriberi continues to be what it has always been, that is, its proportion compared with the total number of deaths of children in the city of Manila is not less than 35 per cent. * * *

This is probably due to the fact that the mothers do not call a doctor for the proper treatment of their beriberic children and, secondly, to the fact that the doctor either does not diagnose correctly or uses an extract which does not possess the qualities which our experience has sanctioned.[1]

REORGANIZATION ACT No. 2666

An Act of the First Session of the Fourth Philippine Legislature to take effect on its approval to reorganize the Executive Departments of the Government of the Philippine Islands was approved on November 18, 1916. This Act transferred the Bureau of Science from the Department of the Interior. In part it reads as follows:

SEC. 7. *Bureaus and offices under the Department of Agriculture and Natural Resources.*—The Department of Agriculture and Natural Resources

[1] Translated from the Spanish.

shall have the direct executive control, direction, and supervision of the Bureau of Agriculture, the Bureau of Forestry, the Bureau of Lands, matters pertaining to colonies and plantations on public lands, the Bureau of Science, the Weather Bureau, and matters concerning hunting, fisheries, sponges, and other sea products, and such other as may hereafter be assigned to it by law.

NECESSITY FOR RESEARCH

Almost daily inquiries come to the Bureau of Science with regard to Philippine problems. We should keep studying the possible resources, the health and other problems of the Islands, be prepared in so far as possible for questions as they come up and have information on hand when it is needed. The wonderful possibilities of this country should be studied to avoid waste wherever possible. The value of a scientist is his ability to work out problems without misdirected effort, rather than his accumulation of facts. Experience in working with problems enables a man to attack them without a waste of time, and experience in the Philippine Islands enables him to adapt his investigations to tropical conditions. Economic work in practically all scientific lines is primarily dependent on technical investigations. It is not always easy to see the practical bearing of certain pieces of scientific investigation, yet it is surprising how often the seemingly useless and impractical will be found of vital importance. Pasteur's experiments to disprove the theory of spontaneous generation were not looked upon as of any practical value at the time they were undertaken, yet they are the basis of the modern practice of sterilization, and the noun "pasteurization" perpetuates the author's name. Geology, the study of rocks, may seem dry and useless, yet this study is necessary for the discovery and recovery of such useful substances as iron, gold, coal, and petroleum. Conditions in the Philippines are different from those in countries that are more highly developed economically. Work done in other countries is frequently not directly applicable here, and there are many problems to be solved that have not been considered elsewhere.

COMPENSATION OF SCIENTIFIC EMPLOYEES

The question of salaries of scientific employees is difficult to decide. Scientific positions should be filled by men of training and ability, and the supply of able men is limited. The material equipment of this institution is excellent, but material equipment without good men is of no avail. It is not equipment so much as the ability of the men that makes an institution. Medi-

ocre men can do certain classes of routine scientific work, but it requires capable men to apply their training to their problems. A well-trained man is able to work out the problems which are to be solved by experimentation. Able men must be retained. Mediocre men cannot do any real constructive work. A man must be well trained and feel himself a part of the institution in which he is employed to do his best work. Low-salaried positions are used only as stepping stones to something else. Scientific men who are satisfied with low-salaried positions are usually of mediocre ability, and a changing personnel is most expensive. Economic rocks, plants, insects, etc., must be accurately known before economic data can be made available. The geologist, botanist, entomologist, or other specialist having long experience in a country can in a very high percentage of cases answer a query offhand that a novice would not be able to answer at all, or only after many hours or even days of critical study. Only when an institution has a certain permanency of personnel can the work progress. The necessity for a permanency of personnel in the Philippine Islands is felt more than elsewhere because conditions are unique, and technologists frequently must serve an apprenticeship before they become of great value. A new man spends much of his time and energy during the first year or two in becoming adjusted to new conditions. The work of the Bureau of Science is so important that we should continue to attract and retain men of the highest ability. Our work is so complicated that we must retain a permanent nucleus, and to do this men must be contented and satisfied with their future outlook.

Scientific work requires long years of training. In addition to an ordinary education a scientist devotes from five to eight years to further study. During this period he draws no salary, and his expenses are large. On the other hand, during the same period a clerk, an internal revenue agent, or a customs inspector not only does not have to meet educational expenses, but draws a salary. In view of these facts, the salaries now paid to scientific employees are very low in comparison with those allowed clerks, mechanics, etc. Any reduction in salaries or a disinclination to make promotions will mean that competent men will soon find more lucrative positions elsewhere.

Unfortunately there are a great many lines of scientific work to which the Filipino youth is not attracted. There are other lines for which there are no training facilities provided in the Philippine Islands. The Filipino youths are attracted to the

exact sciences and to medicine more than to the lesser biological sciences. This is probably as it should be for some time to come, for in certain lines wholesale quantities of trained men are needed, and it is more likely that a man will fit where there are many opportunities from which to choose. It should be realized that the development of the Philippine Islands in competition with the world must more and more depend on competent scientists. The Philippine Islands have an advantage in having started right and in not having to waste their raw materials or jeopardize their natural resources by careless exploitation.

PUBLICITY

The inhabitants of these Islands are not getting as great benefit from the work which the Bureau of Science has done as they ought to be getting. In this institution there is unquestionably a great deal of information on many subjects that would benefit or improve agricultural, health, mining, industrial, commercial, and other economic conditions if brought before the people in the right way. The Bureau of Science has done and is doing work that is important to the Philippine Islands and has prepared, published, and circulated throughout the Islands reports and statistical information concerning its work that has aided and will continue to aid industrial and commercial development. The large amount of good done by these is becoming increasingly evident. However, a large percentage of the people who need assistance are unable to derive it solely from publications. To men not trained to use them, written regulations and directions often seem more or less impractical, but when such men actually see the work performed and the results accomplished, they are readily convinced of the importance of doing work scientifically. For example, many owners of salt farms are not trained to make use of literature put into their hands, but can readily learn from actual demonstration.

From the little that has been done to demonstrate the various lines of work of the Bureau of Science it has been found that the people are quick to see the value of such work and are sincerely appreciative of what it will do for them. If representatives from the Bureau of Science be sent among the people to demonstrate improved methods of procedure along such lines as the utilization of waste products, the development of mineral resources, the production of better leather, the utilization of forest products, the use of medicinal plants, the conservation and

increase of sea products, the relation of insects and birds to agriculture and to man and domestic animals, the better utilization of products such as sugar cane and the nipa palm, the adaptation of soils to crops, etc., and to introduce new and better industries of immediate and vital interest to the inhabitants of these Islands, it will be possible to bring about needed reforms and an improvement of their economic conditions much more rapidly. This has been done to a limited extent among the sugar growers of Negros. Their appreciation of this work and their desire for further help of this kind is conclusively shown in the letters included in this report.

With its limited personnel and the scientific staff overloaded with routine work, it is impossible for the Bureau of Science to devote time to the proper demonstration and explanation of the information that it has available. On the other hand, the Bureau of Science does want the people to understand and appreciate its work, for only through the people's confidence and sympathy can the Bureau best fulfill its functions. There is immediate need for a number of statisticians and demontrators to place before the public the collected data and the results of experiments, to demonstrate new and improved methods, and to introduce new industries. It seems reasonable to suppose that the extra expense involved in this form of publicity would be amply justified.

BIOLOGICAL LABORATORY

Personnel.—Dr. J. A. Johnston was absent on leave from October 4, 1915, to April 1, 1916. Dr. H. W. Wade reported for duty February 2. Dr. O. Schöbl, who resigned while on leave, accepted reappointment and returned to duty on March 7. Dr. B. C. Crowell was transferred to the University of the Philippines, where he has been detailed for half time for several years. Dr. E. H. Ruediger was retired on April 25, since which time the section of sera and vaccines has been in charge of Doctor Schöbl. Doctor Panganiban, veterinarian, and Doctors Navarro, Monserrat, and Liboro, physicians, have been appointed and assigned to duty in the laboratory.

Routine.—After a period of quiescence during the first three months cholera again assumed noticeable proportions in April and continues up to December 31. The work of this laboratory has convincingly shown the continuance and spread of the disease to be due to "carriers." In this connection, in coöperation with the Philippine Health Service, a systematic examination

of all those connected with the handling of food has been carried out.

In addition to the large number of fæcal specimens for cholera, routine examinations of water, milk, blood, sputum, plague, leprosy, gonococci, urine, foodstuffs, etc., have been performed.

Sanitary Health Commissions.—The Bureau of Science has continued the supervision of the bacteriological work of the Sanitary Health Commissions. This institution does not have sufficient personnel to do all of the bacteriological work, but one assistant has been constantly detailed to provincial duty.

General.—Twice during the year the Bureau of Science has complied with a request of the Director of Health for an assistant bacteriologist to be detailed for provincial laboratory work to suppress severe local outbreaks of cholera. Owing to more intelligent coöperation on the part of subordinate health officials, in taking and forwarding laboratory specimens, the Bureau of Science has been able to detect a greater percentage of the positive cases of cholera and cholera carriers from the provinces than ever before. Further investigations of the cholera-carrier problem are being carried on. Studies in leprosy previously reported are still in progress. Since this is a disease of long incubation, observation must necessarily be continued over a period of years. In the routine examination of rats one case of chronic or resolvent plague was discovered. An extensive study of fungus and allied skin infections is now underway. The published articles are given under the Philippine Journal of Science, Section B, on page 41.

Laboratory for sera and vaccines.—By a rearrangement of space three workrooms have been added to the rooms formerly used as laboratories in connection with serum work. The arrangement makes it possible to prepare and sterilize small glassware, such as graduated cylinders, pipettes, beakers, test tubes, Petri dishes, etc., without interference with the main sterilizing plant, which is taxed to its maximum by the work in connection with cholera examinations and general bacteriological work. Large pieces of glassware and apparatus used for bleeding, filtering, and filling of biological products are being prepared and sterilized in an autoclave located in front of the serum and bottling rooms.

The manufacture of these biologic products has been facilitated by the addition of three assistants, two of whom are medical

men and the other a veterinarian, and also by the detailing of a junior officer of the United States Public Health Service for part-time duty. They have been engaged in performing the daily routine work, such as Wassermann test, preparation of stock autogenous bacterial vaccine, preparation of antirabic vaccine, administration of Pasteur treatment, immunization and bleeding of horses for serum, and preparation of smallpox vaccine. The work accomplished is indicated by the following table:

Sera and vaccines bottled and disposed of at the Bureau of Science from January 1 to December 31, 1916.

Article.		Bottled.	Disposed of.
Antitetanic serum	units	297,000	2,298,700
Antidiphtheritic serum	do	121,000	90,000
Antidysenteric serum	cc	1,620	5,122
Antistreptococcus serum	do	240	1,830
Antimeningococcic serum	do		3,370
Antiplague serum	do		1,020
Anticholera serum	do	39	24
Antityphoid serum	do	3,859	41
Normal horse serum	do	30,470	37,460
Typhoid vaccine	ampuls	860	977
Typhoid and paratyphoid A & B vaccine	do	442	109
Dysentery vaccine	do	132	73
Cholera vaccine	do	2,685	2,120
B. coli vaccine	do	312	116
Streptococcus vaccine	do	175	51
Plague prophylactic	cc		3,330
Glycerinated plague vaccine	ampuls		703
Cholera prophylactic	cc		8,966
Gonococcus vaccine	ampuls	2,164	2,140
Staphylococcus albus aureus vaccine	do	249	672
Staphylococcus aureus vaccine	do	120	3
Streptococcus-Staphylococcus aureus albus vaccine	do	120	12
Autogenous vaccine	do	470	470
Anthrax vaccine No. 1	cc		1,879
Anthrax vaccine No. 2	do		1,780
Staphylococcus albus vaccine	ampuls	405	123
Rabies vaccine		(a)	(a)
Tuberculin (human)	cc	71	211
Tuberculin (bovine)	do	50	96
Vaccine virus	doses	1,744,770	1,569,014
Mallein	do	540	971
Antisheep hæmolytic amboceptor	units		3,000

[a] The Pasteur treatment for rabies is now much more appreciated than formerly as shown by the following record of treatments:

Number of patients who received treatment at the Bureau of Science	94
Number of treatments sent by the Bureau of Science to outpatients	119
Total	213

SECTION OF BOTANY

Personnel.—The technical force remains the same as for the past year, with the addition of Dr. Leon Ma. Guerrero, who was appointed early in the year for the purpose of undertaking a survey of the medicinal plants of the Archipelago. Chief botanist E. D. Merrill was on leave of absence in the United States from April 5, 1915, to January 3, 1916. The relations of Mr. E. D. Merrill and Dr. W. H. Brown with the University are the same as during 1915, the services of the former being shared by the Bureau of Science with the University on an equal basis, and the latter, primarily employed by the University, being detailed to the Bureau of Science for certain work. By this arrangement Mr. Merrill has continued as head of the botanical department of the University, and at the same time both gentlemen have opportunity to do much technical research work.

The time utilized for the University is to a large degree offset by delegating much routine work to clerical employees who have been trained in certain lines, so the botanical output of the Bureau of Science has not been greatly restricted.

Exploration.—Messrs. Fenix, Ramos, and Edaño have successfully carried on field work in the following regions: Northern Samar; Bukidnon, Mindanao; and Nueva Ecija and Tayabas Provinces, Luzon. Smaller collections have been made in Laguna, Cavite, Rizal, Zambales, La Union, Ilocos Norte, Ilocos Sur, and other provinces. Dr. H. S. Yates made one extensive trip in Mountain Province and a shorter one in southern Tayabas, for the purpose of collecting fungi. Doctors Yates and Brown and Mr. Merrill have made an examination of the revegetation of Taal Volcano. Mr. Merrill spent three weeks' vacation in Kwangtung Province, China, in collecting and preparing botanical material.

One extensive trip of Mr. Fenix was devoted wholly to the investigations of the bast-fiber plants and bast-rope industry in the Ilocano provinces, Luzon. He collected botanical material and fiber specimens from all the plants utilized by the Filipinos in making rope and secured several hundred meters of each kind of rope, which are to be tested for strength, durability, etc.

Mycology.—When Doctor Yates arrived last year he found the mycological collections in a chaotic condition and has devoted much time to the arrangement of the material already identified. This phase of the work is now completed. He has carried on work in connection with the outbreak of bud rot in the coconut

region of Laguna and on the citrus canker in Mountain Province and has devoted much time to a study of the molds affecting copra. Field investigation has been made, and some inoculation experiments have been performed in a study of the cause of coconut bud rot.

Physiology.—The field work on the relation of environment to physical types of vegetation at different altitudes on Mount Maquiling was completed in 1915. Doctor Brown has made much progress in the task now in hand of correlating and interpreting nearly three years of field data, and this large work should be completed during the coming year. During this year he has initiated and nearly completed a series of field observations on Mount Banajao, with a view to complete a similar piece of work in relation to the vegetation of Mount Banajao, for purposes of comparison with that of Mount Maquiling.

In coöperation with Mr. G. W. Heise, of the division of inorganic chemistry, he has prepared for publication an article on the relation of light intensity to carbon dioxide assimilation and has planned a series of experiments for a further investigation of the problem. In coöperation with Mr. A. S. Argüelles he has in preparation a paper on the relation of soils to vegetation on Mount Maquiling. With Doctor Yates he has done the necessary field work and is now writing up the results in relation to the revegetation of Taal Volcano since the eruption of 1911.

Morphology of the volvocales.—This work has been carried on during the past year in the botanical laboratory of the Bureau of Science by Dr. W. R. Shaw, of the University of the Philippines. The project is now well advanced, and the results promise to be of great interest. Doctor Shaw has developed improved methods for collecting, preserving, staining, mounting, and photographing these minute organisms, and in the course of his work he has discovered several new generic types and undescribed species.

Medicinal plant survey.—This work was initiated early in the year, and its progress has been satisfactory. An effort is being made to compile all data of interest regarding medicinal, reputed medicinal, and poisonous plants of the Philippines; to identify the plants; and to select for chemical, pharmaceutical, and medicinal investigation those species of promise.

Systematic investigations.—Several thousand specimens that accumulated during Mr. Merrill's absence have been identified. Current collections made by employees of the Bureaus of Science and Forestry and by various private individuals have been also named and reported. General work on the Philippine flora has

progressed satisfactorily. Mr. Merrill has completed a study of the Robinson Amboina collections, and his very exhaustive and critical paper entitled An Interpretation of Rumphius's Herbarium Amboinense is in the hands of the printer.

The revision of all the Philippine species described by Blanco and by Llanos has been completed. Work on this project has been in progress for the past four years.

The herbarium.—The growth of the herbarium has been satisfactory in spite of the fact that the European war has reduced exchanges to a minimum. A general rearrangement of the material is in progress, with the object of making specimens from special regions more easily available.

Philippine accessions.—Specimens have been received by collection, gift, for identification, and by transmission from other branches of the Government. The collections of Philippine material are:

Collections of the employees of the Bureau of Science	2,512
Collections of the employees of the Bureau of Forestry	2,991
Miscellaneous collections of Messrs. C. F. Baker, H. Sandkuhl, C. A. Wenzel, N. Teodoro, M. Sablaya, C. M. Weber, R. Lete, P. J. Wester, and Mrs. Clemens	2,141
Total specimens	7,644

Foreign accessions.—The foreign accessions are as follows:

Mrs. Clemens, Kinabalu expedition, Borneo	1,839
Mr. Topping, Kinabalu ferns	560
Miscellaneous fungi from the U. S. Department of Agriculture, exchange	708
Miscellaneous Malayan duplicates from the Botanic Garden, Buitenzorg, exchange	152
Miscellaneous duplicates from the Botanic Garden, Singapore, exchange	194
Bornean collections of Messrs. F. W. Foxworthy and A. Villamil	286
Guam plants, collected by A. Guerrero	88
Kinabalu collections of G. A. G. Haslam	101
Kwangtung collections of E. D. Merrill	601
Western Australian plants, ex herb. A. Morison from Edinburgh Botanic Garden, exchange	1,831
Total specimens	6,594

The total accessions for the year are 14,238 specimens, which have been poisoned, mounted, and so distributed as to be available to all who have occasion to consult them. The number of specimens in the herbarium now totals 172,518, of which about 73,000 are extra-Philippine.

ficient to show the nature of the field for investigation offered in the study of the food of this species of bird. The grebe may be injurious to the shrimp fishermen, but on the other hand it is possible that the water bug which it eats is injurious to the young fishes. Therefore further study is necessary before this bird can be classified as injurious or beneficial.

These two illustrations show the importance of including all species of birds in the food investigation. Birds that are least expected to be of economic importance may prove to be highly beneficial or injurious.

In connection with the food investigation a blank has been prepared asking for information on the food habits of birds. This blank will be sent to members of the Agricultural Congress for the purpose of obtaining data as to what birds are injurious or beneficial to the farmer in various provinces. A circular letter has been printed to be sent with the blanks. The president of the Congress has approved this plan and promised the co-operation of the members.

Bureau of Science press bulletin No. 32, which was distributed September 23, 1914, has been revised and illustrated with small cuts of some Philippine birds. This is issued as a 14-page pamphlet with the title Birds in their Economic Relation to Man. The pamphlet is intended for distribution in the Philippine Islands in order to call attention to the very practical value of birds as protectors of forests, crops, etc.

Miscellaneous work was carried on as follows: Commercial taxidermic work such as mounting specimens of birds and fruit bats; the sale of scientific specimens to collectors in the United States; the dispatch of six cases of mounted birds for exhibition at the Northern Luzon Fair at Baguio; 500 numbers of plant specimens collected for the section of botany and for identification of food of birds; a series of rat specimens sent to the United States National Museum for identification in order to determine the host of the flea responsible for the transmission of plague; birds sent to the United States National Museum for identification; etc. Specimens have been gradually added to the collection of birds, and new or rare species have been reported.

SECTION OF ENTOMOLOGY

There was no appropriation for an entomologist; consequently none has been on duty during the year, and all the work accomplished by this section has been done under the supervision of the ornithologist. The regular stock of silkworms has been carried through the year. Those who have applied for silkworms

have been informed that if they have a sufficient number of mulberry trees under cultivation to provide food for the silkworms, the Bureau of Science will be glad to furnish eggs with which to start. Eggs and cocoons have been supplied to those who were prepared to raise them, and instructions in the care of the worms have been given to several persons who wished to establish silk farms.

The production of silk is well suited to the people and the conditions in the Philippine Islands. The many years' work at the Bureau of Science has fully demonstrated that silk can be produced, but it is not to be expected that under present conditions the desired growth of the industry will result. The necessity for demonstrators to carry on this work is pointed out on page 54.

Efforts are being made again to introduce the eri silkworm, which feeds on the leaves of the castor plant. The cloth woven from the silk of this silkworm is believed to be of superior quality. However, it is to be remembered that the silk of the ordinary silkworm is a well-known product with a market value, while eri silk is little more than a curiosity, which even if produced in quantity would require time and money to introduce to the world.

Dr. R. P. Cowles, of the University of the Philippines, has taken advantage of the facilities at the Bureau of Science in order to carry on some experiments in breeding silkworms. There is a large amount of practical work as to the best races of silkworms that should be introduced and crossed with our own in order to retain the present stock in vigor and free from danger of disease.

CHEMICAL LABORATORY

Personnel.—See division of general, inorganic, and physical chemistry and division of organic chemistry.

INVESTIGATION

The effect of the European war has been greatly to increase the burden of work on the chemical laboratory of the Bureau of Science. Many supplies have been cut off from the Philippines by the inability of certain countries to keep up their manufacturing industries and by the tremendously increased and continually increasing freight rates. In connection with its regular routine work the chemical laboratory has been called upon to solve problems that required much research ability. For example, new bleaching methods have been made possible to several enterprises. Many industries have been improved and adapted to war condi-

sistance is available, and accurate results can be obtained only by the examination of hundreds of bird stomachs collected throughout the year. Several hundred stomachs have been examined, and the results have been recorded for future use. Additional material is on hand awaiting examination.

Many of the blank forms, which were distributed with the leaflet entitled Food and Habits of Philippine Birds, have been returned to the Bureau with a large quantity of information. This material will be issued in popular form as soon as it can be properly prepared.

A little has been done on the classification of specimens when time was available. One short paper, New or Noteworthy Philippine Birds, I, was published in the Philippine Journal of Science.

The taxidermist has preserved specimens of birds and snake skins and has mounted several heads and horns of the wild carabao and of the timarao. The latter animal is found only on Mindoro Island and is of much scientific interest. It is said that the timarao resembles the anoa, of Celebes. Because of the increase in taxidermic work an assistant to the taxidermist has been employed.

SECTION OF ENTOMOLOGY

This institution continues without the services of an entomologist, as no appropriation has been made for this important work, although specialists in this line are very much needed. The rearing of silkworms has been continued under the supervision of the ornithologist without change. There are frequent requests for eggs and for information in regard to the cultivation of mulberry plants and as to the commercial possibilities of silk culture in the Islands. As an aid to those wishing to establish mulberry plants, press bulletin 55, in English and in Spanish, was distributed in September.

An attempt was made to import the eri silkworm from Ceylon, but unfortunately the cocoons were sent to us by way of England and were worthless when received. A small area in Malate Park has been planted, partly with mulberry and partly with castor plants. The leaves of the latter will be used to feed eri worms if they are later introduced.

The rearing of silkworms seems in many ways adapted to this country and to its people, but for the development of the industry the Government should employ an expert sericulturist. Silk, like other animal and plant products, to be of good quality must

be the product of selected stock and skillful rearing. To gain and retain a good name for Philippine silk, a silk expert is needed. To develop the industry there should be demonstrators, trained by the expert, who will establish small silkhouses where the people can bé shown the possibilities of this industry.

CHEMICAL LABORATORY

DIVISION OF GENERAL, INORGANIC, AND PHYSICAL CHEMISTRY

The plan which I inaugurated last year of operating the division of general, inorganic, and physical chemistry under three superintendents of section who would report directly to me has been entirely satisfactory. The sections continue to be designated (1) Section of analytical chemistry: Rocks, minerals, ores, slags, clays, limes; plasters, soils, fertilizers, etc.; iron and steel; metals and alloys; pigments and mixed paints, including vehicles; fuels, including calorific value; gas; inorganic chemicals and other inorganic analyses, except fire assays. (2) Section of weights, measures, water analysis, and physical chemistry: Waters, sewage, corrosion; weights and measures; instruments and apparatus such as thermometers, pyrometers, microscopes, refractometers, and other physical and chemical apparatus. (3) Section of physical and mechanical testing: Cements, aggregates; iron and steel; road materials; tar, asphalt, and bitumen; stone, twine, ropes, wires, khaki cloths, fuels, etc.; and the standardization of other classes of supplies.

The personnel of the sections remains unchanged, except that in the section of weights, measures, water analysis, and physical chemistry, to fill a vacancy which has existed since January, Mr. A. S. Behrman was transferred from the Bureau of Education on June 1, 1916, and was trained especially for the field work in water analysis. Mr. V. Q. Gana resigned, effective May 9, 1916. Mr. J. Gonzales, who has served as a temporary employee, was assigned to routine work in the water laboratory. He qualified on November 6, 1916, for regular appointment in the classified service. Mr. F. M. Villanueva has been employed since November 9, 1916, in the section of physical and mechanical testing, where he is at present engaged in an investigation of the manufacture of roofing tiles. There has been the closest coöperation between the sections, men have been transferred temporarily from one section to another, and there has been no confusion, overlapping, or neglect of work.

Routine.—The routine work accomplished by the division of general, inorganic, and physical chemistry has been as great as,

or greater in variety than, in former years, and the amount is shown in the following general summary:

Nature of material.	1915	1916
Metals and alloys	44	19
Rocks and minerals	15	95
Natural pigments and varnishes		20
Clays, shales, limestone, limes, wall plasters, cements, and slags	5	10
Fertilizers	34	72
Soils and similar substances	365	18
Coal analyses	50	10
Calorimetric tests of fuels	34	7
Waters	201	161
Crude inorganic chemicals (preparation and analysis) and miscellaneous analyses	135	161
Standard solutions	20	304
Examination for sea-water damage	(a)	58
Physical tests of wire, twine, fiber, textile, paper, steel, tar, asphalt, etc	32	4
Cements	6,716	15,909
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, wood, iron, steel, etc	203	468
Standardization of road materials	71	67
Standardization of unites of measures:		
Lengths	60	679
Capacities	121	56
Weights	31	20
Miscellaneous	22	19

[a] Included under "Miscellaneous analyses."

The number of samples of water analyzed shows a slight decrease from the preceding year, owing partly to the greatly increased volume of field water work and partly to the decrease in well-drilling operations by the Bureau of Public Works.

In the preceding table many of the results represent more than ordinary routine work, for frequently members of the various sections have been called upon to pass judgment on the quality and the commercial value of the samples submitted for analysis. In several instances additional experiments were necessary to solve various problems of commercial importance. Considering the fact that in many cases, for example, examination for sea-water damage, the sample may represent many thousands of pesos, it is evident that the greatest care and precision is necessary in all of this work.

All the apparatus being used are standardized and checked, and precautions are taken to maintain the highest standard of work. During this year the output of each cement briquette maker has been studied, and those who cannot uniformly maintain a certain standard are eliminated or transferred to other

classes of work and their places filled by those having the required ability. With the object of encouraging briquette molders to put forth their best efforts, a bonus system has been devised. Although received irregularly, the number of cements tested has been greater than during any former year. Not only has there been a large number of requests at one time for cement tests, but also requests asking that certain samples be rushed. In order to complete all of the work without delay, the laboratory has been arranged so that at any time the output can be temporarily doubled by detailing some of the regular shifts to night duty and filling the gaps with new recruits.

INVESTIGATION

In this division, as in the other branches of the Bureau of Science, a scientific study of Philippine problems is indispensable and men can be of the greatest value only when they devote considerable time to careful study. This study is guided along the lines of Philippine industry.

The present European war has brought about a shortage of, and an increase in, the price of sodium peroxide, the chief chemical used for bleaching native hats. In order to remedy this shortage and to make bleaching agents available, the Bureau of Science has carried on a number of experiments with a view to find other chemicals obtainable in the local market at a reasonable price that would serve equally well. The results of these experiments show that sodium hypochlorite is adapted for bleaching native hats and can very well replace sodium peroxide. It is now being used by some hat factories for this purpose. Sodium hypochlorite can be readily prepared from bleaching powder and sodium carbonate or by direct electrolysis of a solution of common salt. The preparation of sodium hypochlorite from bleaching powder and sodium carbonate has been found economically possible on account of the fact that these chemicals are available in the local market and can be readily secured from Japan or from the United States at reasonable prices. The preparation of sodium hypochlorite by direct electrolysis of salt brine requires an initial outlay, but in the long run is more economical than the other process. With either of these two processes a cheaper bleaching agent than sodium peroxide can be produced.

After several years of planning, we were able to keep a man for over six months of the year at field work in water analysis.

This has been the best year up to date for the field survey of Philippine water supplies. Almost 200 examinations of water were made at the source. Rizal, Laguna, Sorsogon, and Cebu Provinces were visited. Practically every place visited had specific problems for which we were able to suggest solutions. Several town were considering municipal supply projects. In a number of cases the choice lay between two sources, and our representative was able to designate the more desirable. In one instance work had been begun with the intention of using water of doubtful character.

In addition to the field water work we are endeavoring to classify all of the water data on hand with a view to eliminate obsolete data, secure the exact location of the sources of the various waters analyzed, and make available our present knowledge of Philippine waters. We have continued our campaign of instruction in endeavoring to prevent samples being taken from new wells before they have been pumped long enough for the water to be representative. Generally the first water from a well is poorer than that taken after continued pumping, probably due to the leaching of soluble ingredients in the water stratum. Early samples are useless and may result in the condemnation of what might have been a good well. For example, a certain well yielded water containing no harmful ingredients but was so turbid and unpalatable that the inhabitants used water from a questionable source in its stead. Finally when water was desired for a municipal supply, on the recommendation of this institution, the abandoned well was subjected to a protracted pumping test, whereupon the water became clear and unobjectionable. It may be expensive to retain a well-drilling outfit long after a well is completed, especially when other sections are clamoring for wells, but it may be that the benefit in so doing outweighs the disadvantages and may prove less expensive in the long run. In the case cited a thorough pumping test when the well was first installed would not only have saved trouble and the expense of unnecessary travel and analyses, but what is more important would have made available almost a year sooner a badly needed source of water.

Owing to the unsatisfactory results achieved by the steam sterilization of demijohns used locally in connection with the sale of artesian water, new cleaning methods were devised by the Bureau of Science and successfully installed. These methods, which consist of thorough cleaning, sterilization with chloride

of lime, and rinsing, require a minimum amount of handling of the demijohns, are economical, and with adequate supervision, practically insure sterile containers. These methods are the most successful yet tried and are in use by several companies.

Information concerning several other phases of water investigation is being accumulated. Work on the analysis of Manila rain water shows that in the vicinity of Manila approximately 165 kilograms of salt fall annually with the rain on each hectare of ground. Work on the standardization of methods of analysis and in modifying and improving the existing methods is continually in progress. Some data has been accumulated on the changes undergone by water samples bottled under various conditions. Many of the best known Philippine "mineral" springs and baths have been examined for radioactivity. When completed, the results should materially contribute to our knowledge of Philippine water supplies and geology and should be of more than local interest. As the result of our examination, one company advertising its bottled water as "containing radium" has discontinued the offending advertising.

With the coöperation of the Bureau of Public Works a large test fence has been made, apparatus has been constructed and standardized, and iron plates for exposure tests have been pickled and are stored awaiting use. The methods of making paint films and of determining the drying power, tensile strength, elasticity, and porosity of films have been worked out. The work will proceed as soon as the paint materials are furnished by the Bureau of Public Works.

Work on lumbang oil with respect to its use alone or in mixtures with linseed oil for paint is in progress. The effect of various dryers has been also studied.

The new lime kiln was completed during the year, and a beginning of the study of the manufacture of lime from Philippine limestone in this experimental kiln has been made.

A large number of investigations on cement, clays, tie materials, and concrete, including a study of failures of concrete construction throughout the Islands, the behavior of concrete made from certain aggregates obtained locally, and the effect of various electrolytes on cement, are underway. In the assistance to the local tanning, in the investigation of galvanized iron, etc., as much has been accomplished as the pressure of more urgent work would permit. Coöperation with the section of botany is mentioned on page 24. There are many lines of

work that should receive careful study, which it is impossible to undertake because of lack of personnel.

Topics upon which articles have been published have not been incorporated in this discussion, but are included under the heading Philippine Journal of Science, Section A, on page 40.

DIVISION OF ORGANIC CHEMISTRY

Personnel.—Dr. H. C. Brill, who had been acting chief of the division of organic chemistry, was regularly appointed on January 1, 1916. In addition the personnel consisted of Messrs. Albert H. Wells, Leavitt W. Thurlow, Harrison O. Parker, Francisco Agcaoili, J. F. Armstrong, F. T. Rosado, and Hermenegildo Taguibao. Of these members Mr. Wells returned from leave in the United States on April 3, 1916; Mr. Thurlow spent the year at the Bureau of Science Sugar Laboratory in Iloilo except the periods from December 4, 1915, to January 8, 1916, and from August 17, 1916, to November 18, 1916, which were spent in Manila. Mr. Agcaoili was on leave from April 3, 1916, to June 10, 1916, and was absent because of illness from September 18, 1916, to October 12, 1916; Mr. Rosado was transferred from the Bureau of Public Works on September 2, 1916, and was detailed to Iloilo on December 16, 1916; Mr. Armstrong gave all his time to the work of the sugar laboratory at Iloilo; the other members of the staff have spent all their time in the laboratory in Manila.

ROUTINE WORK

Mr. Wells has been placed in direct charge of the routine work of the division and designated the representative of this institution on the Board of Food and Drug Inspection. The routine work of the division has remained of the same character as heretofore as shown by the appended table of work accomplished. The number of samples examined was 1,763, which is slightly more than in previous years except last year, when the campaign carried out against the use of saccharine in bakery products resulted in an augmentation of the number of samples of this product examined.

The extract of tiqui-tiqui for the Liga Nacional Filipina para la Proteccion de la Primera Infancia is still prepared by this division. Before the departure of Mr. R. R. Williams, who had personal charge of this work, considerable difficulty had been experienced in the sterilization of the preparation. The problem

nas been solved by the use of fractional sterilization, and I am gratified to say that the officers of the Liga Nacional Filipina para la Proteccion de la Primera Infancia have commended the Bureau of Science as shown elsewhere. On account of the largely increased demand for this extract by the Liga, little has been furnished to outside agencies. Dr. N. M. Saleeby had been securing regularly increasing quantities of the hydrolyzed extract, which he has used in his practice with gratifying result.

Iloilo Sugar Laboratory.—The work of the branch of the division of organic chemistry maintained at Iloilo deserves special mention. Messrs. Thurlow and Armstrong have been able to do a great deal of work toward an extensive and intensive survey of the sugar industry in Panay and Negros. The response of the planters to the advice and counsel of these members of the Bureau staff has been gratifying.

INVESTIGATION

The routine work of the division has occupied a large part of the time of the members, but the investigation of some new problems has been completed, and several others are well underway. The titles of the finished articles are given under Philippine Journal of Science and other publications on page 40. Papers on the following subjects are in manuscript form: Pangium edule and Hydnocarpus alcalae; alcohol from discard molasses in the Philippine Islands; the fermentation of Philippine cacao; the infusorial earth extract of hydrolyzed tiqui-tiqui in the treatment of beriberi chickens; chaulmoogra oil used in the treatment of leprosy; the vitamine content of some Philippine vegetables; the use of the Kjeldahl method in the determination of the nitrogen of cyclic compounds; destructive distillation of Philippine woods with temperature control; the aging of Philippine coco and nipa brandies in charred barrels; the medicinal plants of the Philippine Islands; several papers on various phases of the coconut and copra industry; etc. The work on the coconut industry will be continued. Investigation is in progress on the examination of various rices for vitamine content to determine an equitable basis for classification of degree of polishing; gardenia flower for perfume; nutrition experiments; hydrogenation of Philippine oils; etc. Permission was given to Dr. H. C. Brill to contribute a paper to Tropical Life, at the request of the editor, on The Ferments of Some Tropical Fruits and Vegetables, and to Mr. L. W. Thurlow to publish a paper on The

Sugar Industry in the Philippine Islands, in the Louisiana Planter.

DIVISION OF MINES

Personnel.—Mr. V. E. Lednicky was appointed chief of the division of mines effective July 1, 1916, to succeed Mr. Wallace E. Pratt, who had been on vacation since July 15, 1915, and who was granted retirement effective April 1, 1916, under the provisions of Act No. 2589. During the vacation of Mr. Pratt, Mr. Lednicky served as acting chief. Mr. John P. Goldsberry, petrologist and geologist, reported for duty in Manila January 18, 1916, and since that date has handled the assaying and artesian well sample examinations. The division of mines has been very seriously handicapped by the smallness of the staff during the year, but an attempt has been made to handle as much as possible of the routine work presented. We have not been able to do all of the field work requested. The interest shown in mining by the Government and others warrants a considerably increased geological personnel.

Routine.—About 300 mineral specimens were examined and 200 consultations were had with individuals seeking geological information. A total of 517 assays, 11 bullion smeltings, and 93 placer weighings have been performed. The new Heusser assay balance has given entire satisfaction and has increased the speed and accuracy of weighings. A few leaching and amalgamation tests were made. One hundred ninety artesian well strata cuttings received during the year, together with the samples left over from the former year, have been examined. The usual drafting necessary in the preparation of maps and drawings for publication in the Philippine Journal of Science and other Bureau of Science publications has been carried on. The large relief map of the Philippine Islands, which we made for the Bureau of Science exhibit in San Francisco, has been rebuilt and recolored, and the legend with regard to the key to geology and the principal mineral localities has been added to it.

Field work.—Although the time available for field work was very limited, a comparatively large amount of it was done. Mr. Lednicky spent about half of his time on travel order. Practically all of this was spent in examination work for which the Bureau of Science received expenses and pay. Information valuable to the Bureau of Science was gathered on all of these trips, and considerable help was given the mining industry. During the year I issued the following travel orders for geological work:

Travel orders issued for geological work during the year 1916.

T. O. No.	Name.	Date of departure.	Destination.	Purpose of trip.
541	V. E. L., J. P. G.	Nov. 10, 1916	Mindanao	To examine the Cansuran Placer Co. property.
517	V. E. L.	Sept. 15, 1916	Aroroy, Masbate	To make a geological reconnaissance of a mining proposition.
516	V. E. L., J. P. G.	As soon as practicable.	Alabat Island and Polillo Island.	To collect information for the 1916 Mineral Resources and other geological information.
509	V. E. L	On or about July 17, 1916.	Gumaus Placer Co.	To investigate data and conditions of the Gumaus Placer Co.
501	do	July 5, 1916	Batangas	To determine whether or not the Catholic cemetery is a public menace.
497	do	On or about June 27, 1916.	Laguna Province.	Inspection of the geology in the vicinity of spring in Laguna Province studied during the Bureau of Science water survey.
491	do	When convenient.	Bauyahan, Batangas.	To ascertain if limestone is available for rail shipment.
489	do	June 6, 1916	Baguio	To do confidential examination work.
463	do	As soon as the work in Pangasinan is completed (T. O. dated 3/6).	Mancayan copper region.	Geologic work.
462	do	Mar. 7, 1916	Pangasinan copper region.	Do.
458	do	On or about Feb. 29, 1916.	Zambales copper region.	Do.
452	do	Jan. 14, 1916	Mindoro	To do private professional geologic work.
455	J. P. G	do	Sorsogon	To examine Bulusan Volcano.

Mining legislation.—The interest in legislation concerning mining continues, and it is hoped that a rational mining law will be put in operation in the Philippine Islands by the present legislature.

Publications.—It is our intention to issue the Mineral Resources of the Philippine Islands for a given year before March 1 of the following. The issue for 1915 did not appear until late in the year due to numerous delays. The contents were as follows:

Staff, Division of Mines, Bureau of Science.
Philippine mining possibilities, by V. E. Lednicky.
Statistics of mineral production in the Philippines in 1915, by V. E. Lednicky.
Mining in the Philippine Islands, by V. E. Lednicky.
Philippine gold dredging, by Frank B. Ingersoll.
The iron industry in 1915, by V. E. Lednicky.
The salt industry of the Philippine Islands, by T. Dar Juan.
Philippine coals and their use, by F. R. Ycasiano.
The Acupan Mining Company, by V. E. Lednicky.

The papers that the scientists of this division have contributed to the Philippine Journal of Science are included in the list given on page 40.

PHILIPPINE MUSEUM

The portion of the museum exhibits sent to the Panama-Pacific International Exposition in San Francisco has been returned to Manila, and the whole exhibit has been segregated in the Sales Agency Building on the Luneta extension near the Manila Hotel, which was assigned to the Bureau of Science for this purpose. The arrangement of the exhibit in its new location is nearly completed.

LIBRARY

There have been no changes in the personnel of the library except of the temporary apprentices.

Routine.—Publications from all sources added since July 1, 1912, have been fully catalogued as received, and much progress has been made with the cataloguing of books received prior to that date. Practically all serial publications are now catalogued. The following table gives the record of technical work performed:

	Titles.	Volumes.	Parts.	Cards.
Classification and cataloguing	499	6,061	1,781	2,352
Reclassification and cataloguing	149	852	266	648
Total	648	6,913	2,047	3,000
Printed cards prepared and filed				5,220
Total number of cards filed in official catalogue				8,220

An inventory has been completed showing a remarkably small number of losses. The unbound material which has never been accessioned was counted during the year, showing 946 incomplete volumes, 3,024 complete volumes, 17,100 pamphlets, and 644 parts in the library. The accessions during the calendar year were 2,168 volumes, making a total number of 34,200 bound

volumes in the library on December 31. The usual number of exchanges and gifts have been received. Three thousand volumes for the Bureau of Science and 100 volumes for the Weather Bureau were prepared and sent for binding. No work has been done on cuts this year. One complete set of the Philippine Journal of Science was prepared, bound, and forwarded on loan to the New York branch office of the Philippine National Bank.

Union catalogue.—This is the best reference tool in the Philippine Islands, and it is our endeavor to keep it promptly up to date. The accumulation of Library of Congress proof slips on hand at the beginning of the year was filed, and the greater part of the proof received during the year was arranged in two alphabets and filed to "Braz."

Use.—The use has not varied materially from that of recent years, except that the number of scientific workers served by the library is even greater than formerly. The average daily circulation was over 46, and the average number of publications returned daily was 43. The question of "Reserved" books has been worked over during the year, and the resulting list of books reserved appears to be satisfactory.

Library training.—The work of the library science class of the College of Liberal Arts of the University of the Philippines was given by the librarian of the Bureau of Science in the Bureau of Science library from January 1 to the end of the college year and during the period from September to December. The class which entered in 1914 is now in the last semester of the third-year course; no other class has entered during that period. An examination to secure eligibles for a position of assistant librarian was given recently by the Bureau of Civil Service. The practical library questions were extremely nontechnical, yet no one who had not worked in the training course passed. Of the 15 applicants, 6 passed, all of whom are at present members of the class or have had no less than two years of work in the course. Some work has been given to the fifth-year class of the College of Medicine and Surgery, with special emphasis on Government documents as sources of material in medical work, the supervision of manuscripts and bibliographies, etc.

THE PHILIPPINE JOURNAL OF SCIENCE AND OTHER PUBLICATIONS

During 1916 the Philippine Journal of Science was issued as usual in four sections, each of which contained six numbers. Each section is separately paged and indexed. The different sections contained the following:

	Section A.	Section B.	Section C.	Section D.
Pages	300	296	334	453
Plates	5	19	6	11
Text figures	13	22	----------	3

The numbers of the Philippine Journal of Science for Volume XI, 1916, contain the following articles. Names of members of the Bureau of Science staff are marked by asterisks (*).

SECTION A. CHEMICAL AND GEOLOGICAL SCIENCES AND THE INDUSTRIES

No. 1, January, 1916

*Heise, George W. Notes on the water supply of the city of Iloilo.
*Brill, Harvey C., and *Agcaoili, Francisco. Philippine beeswax.
*King, Albert E. W. The pozzuolanic properties of Meycauayan volcanic tuff.
*Heise, George W., and *Aguilar, R. H. The oxygen-consuming power of natural waters.

No. 2, March, 1916

*Williams, Robert R. The chemistry of the vitamines.
*Brill, Harvey C. Diethylsuccinosuccinate: II. A study of the absorption spectra of some derivatives.
———. Hydnocarpus venenata Gaertner: False chaulmoogra.
———. The salicylic acid reaction of beans.

No. 3, May, 1916

*Agcaoili, Francisco. Some vegetables grown in the Philippine Islands.
*Brill, Harvey C. Ipel, a coffee substitute: Leucaena glauca (Linnæus) Bentham.
*Heise, George W., and *Aguilar, R. H. The chemical purification of swimming pools.
*Heise, George W. Note on the tidal variation of springs and deep wells in the Philippine Islands.
*Thurlow, L. W. Manufacture of lime in the Philippine Islands.

No. 4, July, 1916

*Heise, George W., and * Clemente, Amando. The stripping and the analysis of galvanized iron.
*Witt, J. C. The testing of galvanized iron.
———. Comments on the analysis of Babbitt metal.
*Argüelles, Angel S. Galvanized-iron roofing in the Philippines.
*Heise, George W., and *Clemente, Amando. The detinning and analysis of tin plate.

No. 5, September, 1916

*Witt, J. C. Philippine paving-brick materials: A preliminary report.
*Pratt, Wallace E. Philippine lakes.
*Lednicky, V. E. The Palidan-slide mine.
*Goldsberry, J. P. Eruption of Bulusan Volcano.

No. 6, November, 1916

*Brill, Harvey C. Datura alba.
*Gana, Vicente Q. Some Philippine tanbarks.
*Wells, Albert H. Possibilities of gulaman dagat as a substitute for gelatin in food.
*Witt, J. C. The effect of sulphide on cement.
*Behrman, A. S. Note on the Blacher method for the determination of hardness in water.
Reviews.

SECTION B. TROPICAL MEDICINE

No. 1, January, 1916

*Ruediger, E. H. Preservation of human serum for Wassermann reaction.
Mendoza-Guazon, Maria Paz. A case of infestation with Dipylidium caninum.
*Ruediger, E. H. Haemolysis by human serum.
De la Paz, Daniel, and Garcia, Faustino. An experimental study on the use of apomorphine to remove foreign bodies from the respiratory passages.

No. 2, March, 1916

*Gabel, Charles E. Bacteriological examination of swimming pools in Manila.
*Ruediger, E. H. Wassermann reaction with glycerinated human serum.
Reviews.

No. 3, May, 1916

Ruth, Edward S. On the development of twins and other polyembryos with special reference to four sets of duck twins.
Gibson, R. B., and Concepción, Isabelo. The influence of fresh and autoclaved cows' milk on the development of neuritis in animals.
Concepción, Isabelo, and Bulatao, Emilio. Blood-pressure picture of the Filipinos.

No. 4, July, 1916

*Schöbl, Otto. The relation between the amount of cholera culture injected into the gall bladder and the state of cholera carriers in experimental animals.
———. The influence of bile upon the duration of the state of cholera carriers in experimental animals.
*Wade, H. Windsor. Carbohydrate fermentation by Bacillus pestis, comparing certain American and oriental strains, with analysis of discrepancies of fermentations with Hiss's serum water, litmus agar, and bouillon.
Reviews.

No. 5, September, 1916

Garcia, Arturo. Congenital bilateral absence of kidneys in a 140-millimeter pig embryo.
Guerrero, Luis E.; de la Paz, D.; and Guerrero, Alfredo L. Poisoning by Illicium religiosum Siebold.
Boynton, W. H. Rinderpest in swine.
Reviews.

No. 6, November, 1916

*Wade, H. Windsor. Cultivation of a pathogenic fungus which exhibits botryoid and leucocytelike parasitic forms.
Boynton, W. H., and Wharton, L. D. A fatal parasitic infestation.

SECTION C. BOTANY

No. 1, January, 1916

*Merrill, E. D. New plants from Sorsogon Province, Luzon.
De Candolle, C. A new species of Hydnocarpus.
Copeland, E. B. Miscellaneous new ferns.
Copeland, E. B. The genus Loxogramme.

No. 2, March, 1916

*Merrill, E. D. Notes on the flora of Borneo.

No. 3, May, 1916

Van Alderwerelt Van Rosenburgh, C. R. W. K. The Amboina Pteridophyta collected by C. B. Robinson.
*Merrill E. D. New or interesting Philippine Vitaceae.

No. 4, July, 1916

Copeland, Edwin Bingham. Natural selection and the dispersal of species.
———. Hawaiian ferns collected by J. F. Rock.
*Merrill, E. D. New plants from Samar.

No. 5, September, 1916

De Candolle, C. Piperaceae Philippinenses novae vel nuper repertae.
Copeland, E. B. Growth phenomena of Dioscorea.
*Merrill, E. D. Reliquiae Robinsonianae.

No. 6, November, 1916

*Merrill, E. D. Reliquiae Robinsonianae (concluded).

SECTION D. GENERAL BIOLOGY, ETHNOLOGY, AND ANTHROPOLOGY

No. 1, January, 1916

Schultze, W. A catalogue of Philippine Coleoptera.

No. 2, March, 1916

Schultze, W. A catalogue of Philippine Coleoptera (concluded).

No. 3, May, 1916

Banks, Nathan. Neuropteroid insects of the Philippine Islands. (Caddice flies, bark lice, mayflies, and related orders.)
Fleutiaux, Ed. Elateridæ des îles Philippines, II. (New species of Philippine click beetles.)
*Seale, Alvin. Sea products of Mindanao and Sulu, I: Food fishes and sharks.

No. 4, July, 1916

*Seale, Alvin. Sea products of Mindanao and Sulu, II: Pearls, pearl shells, and button shells.
Bunker, Paul D. Nesting of the Philippine glossy starling.
*McGregor, Richard C. New or noteworthy Philippine birds, I.
Kieffer, J. J. Neuer Beitrag zur Kenntnis der philippinischen Cynipiden.
———. Beschreibung einer neuen Mymaride aus den Philippinen.
Schultze, W. II. Beitrag zur coleopteren Fauna der Philippinen.

No. 5, September, 1916

Cockerell, T. D. A. The ceratinid bees of the Philippine Islands.
Muir, Frederick. A new Formosan Purohita (Delphacidae).
Grouvelle, A. Nitidulidæ (Coléoptères) des îles Philippines récoltés par C. F. Baker, II.
Kieffer, J. J. Evaniiden (Hymenoptera) der Philippinen.
Schultze, W. III. Beitrag zur coleopteren Fauna der Philippinen.

No. 6, November, 1916

Oshima, Masamitsu. A collection of termites from the Philippine Islands. (New species of white ants.)
Muir, Frederick. Additions to the known Philippine Delphacidæ (Hemiptera).
Fleutiaux, Ed. Melasidæ (Coléoptères des îles Philippines récoltés par C. F. Baker. (New species of beetles.)
Kieffer, J. J. Beiträge zur Kenntnis der Gattung Loboscelidia Westwood (Hymenoptera). (New species of wasps.)
Kieffer, J. J. Neue Stephanidæ (Hymenoptera) der Philippinen. (New species of Philippine wasps.)

The Mineral Resources of the Philippine Islands for 1915 was issued during the year, as were also publication No. 10, Studies in Philippine Diptera, II, by M. Bezzi, and press bulletin 50, the manufacture of 96-degree sugar by the use of open kettles (cauas) and the vacuum pan. A translation of the latter into the Spanish, entitled Fabricación del azúcar de caña, was also printed, and a Bontoc grammar by Father Vanoverbergh is in galley proof.

The press bulletins issued during the year are as follows:

Press Bulletin No. 48. Importance of soil surveys and Bureau of Science methods of taking samples. (March 23, 1916.)
Press Bulletin No. 49. The Bureau of Science indicates the value of industrial alcohol as motor fuel. (April 28, 1916.)
Press Bulletin No. 50. The manufacture of 96-degree sugar by the use of open kettles (cauas) and the vacuum pan. (August, 1916. Issued in English and Spanish.)
Press Bulletin No. 51. The melting and reboiling of muscavado sugar. (June 27, 1916. Issued in English and Spanish.)

Press Bulletin No. 52. Philippine natural dyestuff materials. (June 16, 1916.)
Press Bulletin No. 53. Philippine bamboo, fibers, and grasses as materials for paper and paper pulp. (August 30, 1916.)
Press Bulletin No. 54. Some industrial possibilities in the Philippine Islands. Prepared on July 17, 1916, as a memorandum for the Hon. Rafael Palma by the Director of the Bureau of Science. (August, 1916. Issued in English and Spanish.)
Press Bulletin No. 55. Planting and care of mulberry trees. (September 11, 1916. Issued in English and Spanish.)
Press Bulletin No. 56. The detection of "carriers" and cholera control. (September, 1916. Issued in English and Spanish.)
Press Bulletin No. 57. Sugar planters suffering from economic waste. (October 9, 1916. Issued in English and Spanish.)
Press Bulletin No. 58. Suggestions to authors: The preparation of manuscript and proof reading for the Philippine Journal of Science and other Bureau of Science publications. (October, 1916.)
Press Bulletin No. 59. Hacenderos show their interest in the erection of modern sugar centrals. (November 10, 1916.)
Press Bulletin No. 60. Water analysis in the Philippines. (November, 1916.)
Letter from Francisco Abelardo addressed to the Director of the Bureau of Science, dated September 2, 1916. (Issued with Bulletin 56.)
Memorandum for the scientific staff of the Bureau of Science, by the Director of the Bureau of Science, dated November 1, 1916.

The ten-year index, begun last year, is now in galley proof. Owing to more urgent work in other lines, work on the index progressed slowly.

The blanks and labels required by the various divisions have been printed.

The mailing list of the Philippine Journal of Science for the past two years has been as follows:

	1915	1916
Paid subscriptions	320	328
Exchanges	470	477
Reviews	66	61
Free	49	48
Total mailing list	905	914

On account of the increased price of paper, etc., a few exchanges and reviews have been discontinued. Some difficulty has been experienced in perfecting and sending exchanges.

Before the advent of the present European war there was a close scientific affiliation between nations, practically a world science. This could be hardly expected to persist to the same

extent during the continuance of hostilities. However, even since the war began, individuals have done work for the Bureau of Science when they were on furlough from the firing line. The Bureau of Science has been particularly fortunate in being able to derive much aid from the world science program, and any interruption of it affects this institution, for less general work applicable to the Philippine Islands is carried on. It is gratifying that during these disturbed times the Philippine Journal of Science has been so fortunate as to have a slight increase in its paid subscription list.

POWER PLANT

There has been no change in the personnel or in the functions of the central power plant for the Philippine General Hospital, the Bureau of Science, and the College of Medicine and Surgery.

Costs.—The electric current generated and delivered at the switchboard is 240,701 kilowatt hours, at an average cost per kilowatt hour of ₱0.077, which is considerably less than for last year. This is due to the fact that the producer-gas plant and gas engine were operated almost continuously during the greater part of the year. During the last month the gas engine was operated for one week only, on account of the lack of suitable coal. Had it not been for this, the average cost per kilowatt hour would have been still lower. The total amount of steam generated in the boilers is 6,934,840 kilograms, at an average cost of ₱0.00303 per kilogram.

Mansfield gas-generating plant.—The total gas generated was nearly 750,000 cubic feet (21,098 cubic meters).

Shop.—The number of shop requests is shown by the following table:

Bureau of Science	313
All other sources	22
Total	335

These requests do not include the setting up of new apparatus, the transfer of installations, or the overhauling and repairing of engines, boilers, automobiles, motorcycles, etc.

CLERICAL DIVISION

Mr. A. E. Southard, chief clerk and business manager of the Philippine Journal of Science, was absent on leave in the United

States from February 16 to June 5. He was detailed to the Executive Bureau from June 16 to September 23 and was retired from the Philippine service on September 24. The duties of Mr. Southard during his absence were performed by the property officer, cashier, and disbursing officer. In order to do this a readjustment of the whole clerical division was necessary. The supervision of the aquarium, except the scientific collections, has continued under the office of the chief clerk. Mr. L. G. Thomas, stenographer and employee in charge of the filing section, resigned effective October 7 to accept a position in a local business house. Mrs. A. M. Seeley is handling the dictation that formerly was attended to by Mr. Thomas. There have been a number of changes and reassignments in the clerical personnel in an effort to acquire the greatest possible efficiency in work that is quite varied and has technical features. The retirement of Mr. Southard has made necessary the temporary assignment of Mr. F. R. Ycasiano, mechanical and testing engineer of this Bureau, to the position of acting chief clerk. I hope to make his assignment as short as possible, for there are other duties for which his services are very much needed.

The office of the Insular Auditor has made a great many changes in the accounting system during the past year. The present system seems to be a vast improvement over the old one and is being intelligently handled by the accounting office, but it appears to require more time of our employees than the former system. Mr. Martinez has had greater responsibility with property work, which he has handled satisfactorily. An additional property officer is very much needed in order that Mr. Martinez may have more available time for property inspection and care. The filing of back correspondence is progressing slowly and as well as could be expected. The current correspondence is filed in good shape.

The Bureau of Science has practically completed raising the low levels of its grounds by excavating the good earth and filling below with ashes from the power plant. My plan in this regard has saved the Government about ₱10,000 in filling charges, besides providing a place for depositing rubbish that otherwise would have had to be carted away.

The breeding of guinea pigs and rabbits has not been so successful as in former years, and it is now very difficult to secure an adequate local supply of rabbits. Arrangements are being made to import them from Japan at a reasonable price.

PHOTOGRAPHY

The record of the photographic work is as follows:

Negatives taken or developed		561
Lantern slides		282
Prints, 5 by 7 inches		4,629
Prints, 8 by 10 inches		582
Prints of various sizes		395
Enlargements		6
Transparencies, 8 by 10 inches		9
Films developed	rolls	14
Films taken and developed	feet	10,000

AQUARIUM

The aquarium of the Bureau of Science continues to be very much appreciated. It has been partially discussed under the heading Section of Fisheries. The aquarium is self-supporting, that is, enough admissions were paid during the year to reimburse the Government for its up-keep. In addition to these, there were 9,257 free admissions to students and teachers of the public schools. There is no question about the educative value of the aquarium, and besides, it affords pleasure and pastime to great numbers.

GARDEN DAY

The Bureau of Science has prepared for display on City of Manila Schools Garden Day, January 27, 1917, at the Tondo Intermediate School, films of industrial, commercial, and scenic subjects in the Philippine Islands. Three free tickets to the aquarium for use on Garden Day will be given to each student who has successfully cultivated a garden during the year.

PHILIPPINE CARNIVAL AND CENTRAL LUZON AGRICULTURAL FAIR

An industrial exhibit is being prepared by the Bureau of Science for display at the Philippine Carnival, February 3–11, 1917, and for the Central Luzon Agricultural Fair to be held in Muñoz, March 12–18, 1917. The films prepared for Garden Day will be also shown in Muñoz.

EXHIBIT AT THE NEW YORK OFFICE OF THE PHILIPPINE NATIONAL BANK

The exhibit prepared consists primarily of photographs and the following Philippine Bureau of Science charts dealing with industrial possibilities in the Archipelago:

PHILIPPINE BUREAU OF SCIENCE CHART 1

SUGARS

[See prints in photograph stand.]

Cane sugar.—Cane sugar is one of the most important products of the Philippine Islands. In 1916 the exportation of sugar from the Archipelago

was about 340,000,000 kilograms, valued at $18,582,000 (₱37,164,000). Negros and Panay have an annual production of about 250,000,000 kilograms, worth about $12,500,000 (₱25,000,000). Sugar cane is also grown on Mindoro and Luzon. The annual production is about 70,000,000 kilograms, valued at $5,000,000 (₱10,000,000). From 20 to 35 per cent of the sucrose is lost in many mills through poor milling and improper methods of handling cane and juice. Opportunity for investment in modern central mills is afforded.

Nipa palm sugar.—The nipa palm, which grows in immense areas on tide lands in various parts of the Philippine Islands, is the source of about 10,000,000 proof gallons of alcohol per annum. It has been shown that nipa sap has a composition similar to that of the juice of the sugar cane and that it can be more profitably used for the production of sugar than for alcohol. There are large areas of nipa swamp that have never been developed.

Buri palm sugar.—Excellent sugar is made from the sap of the buri palm, but the product is absorbed by the local market.

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The nipa palm as a commercial source of sugar; consideration of the principal difficulties encountered in collecting and preserving nipa palm sap, Phil. Journ. Sci., Sec. A (1913), vol. 8, No. 6, 377–398.

The manufacture of sugar from the sap of the buri palm, Phil. Journ. Sci., Sec. A (1911), vol. 6, No. 3, 186–189.

PHILIPPINE BUREAU OF SCIENCE CHART 2

PHILIPPINE ALCOHOL AND BEVERAGES

[See prints in photograph stand.]

Alcohol.—Almost the entire insular production of alcohol—about 10,000,000 proof gallons per annum—is made from the sap of the nipa palm. This palm grows wild in tide-water swamps. There are large areas of nipa swamp land that have not been developed. The discard molasses from the cane-sugar mills annually amounts to about 7,000,000 gallons. This, if converted into alcohol, would produce 5,000,000 proof gallons.

Palm brandy.—Distilled spirits from the fermented sap of nipa and of coconut palms, stored for five years in charred casks, are named "Philippine coco palm brandy" and "Philippine nipa palm brandy." Analyses by the Bureau of Science show that these products conform to the requirements of good brandy.

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PHILIPPINE BUREAU OF SCIENCE CHART 3

COCONUTS

[See prints in photograph stand.]

More copra is exported from the Philippine Islands than from any other country. Copra and coconut oil to the value of $13,900,000 (₱27,800,00) were exported in 1915. The Bureau of Science has shown that the use of the fumes from burning sulphur in the drying process will greatly improve the product. This process has several advantages over the usual methods of drying, namely:

The sulphur fumes prevent the growth of molds during the drying process and make an exceptionally white and uniform product.

There is no loss of oil during the process.

A greater weight of copra is obtained from a given number of nuts, for no oil is destroyed by growing organisms.

The keeping quality of the copra is improved.

The oil is practically colorless, is free from rancidity, and is pronounced equal to, or even better than, the best Cochin oil.

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PHILIPPINE BUREAU OF SCIENCE CHART 4

RESINS, TERPENES, PERFUMES, EDIBLE NUTS, AND VEGETABLE OILS OTHER THAN COCONUT OIL

[See prints in photograph stand.]

Resins and terpenes.—Elemi, balao, apitong, almaciga, and copal find application in the varnish industry and in the making of resin soaps.

Perfumes.—The essential oils of ylang-ylang, champaca, vetiver, lemon grass, orange, cinnamon, and ginger are used in the perfume industry, and several of them are used in the manufacture of nonalcoholic beverages and fruit flavors.

Edible nuts.—The pili nut is very rich in oil. It is very delicious and has a flavor similar to that of the Brazil nut.

Vegetable oils other than coconut oil.—Important vegetable oils, besides coconut oil, are produced in the Philippine Islands from the physic nut, peanut, and pili nut and from the seeds of lumbang, kapok, cato, cashew, castor bean, and cotton. Lumbang oil has good drying qualities and is used in the varnish and the linoleum trades. Other oils now little known may prove to be of commercial value.

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PHILIPPINE BUREAU OF SCIENCE CHART 5

COMMERCIAL PLANT PRODUCTS

[See prints in photograph stand.]

Coffee.—Coffee grows well in several parts of the Philippine Islands, and beans of excellent quality are produced, especially in the highlands of Luzon. Scientific cultivation is probably necessary to increase the output.

Cacao.—First-class cacao is grown to a limited extent in many localities, and the production could be readily increased to export proportions.

Papain.—Papaya gum of as great activity as the best on the market can be and has been produced in the Philippines.

Strychnine.—Strychnine can be extracted from the seeds of *Strychnos ignatii*, a plant indigenous to the Philippines.

Datura alba.—The leaves and the seeds of *Datura alba*, which grows wild in the Philippines, are valuable as an asthma remedy and for other medicinal purposes.

Starch.—Several species of Philippine plants yield a high percentage of starch. The most promising of these are cassava, or camoteng cahoy

(*Manihot utillissima* Poir.), and tapioca. Among other possible sources are arrowroot (*Maranta arundinacea* Linn.); sincamas (*Pachyrhizus erosus* Urban); Polynesian arrowroot (*Tacca pinnatifida* Forst.); yams (Dioscorea); seeds of *Cycas circinalis* Linn.; and the sugar palm (*Arenga saccharifera* Labill.).

Dye materials.—Natural vegetable dyes are used locally. The present production is of slight importance.

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PHILIPPINE BUREAU OF SCIENCE CHART 6

TANNING AND PAPER-PULP MATERIALS

[See prints in photograph stand.]

Tan bark.—The area of the mangrove swamps of the Philippine Islands is estimated to be 207,000 hectares (511,500 acres). The bark from the mangrove yields an excellent tanning material. Cutch, the evaporated water-extract of tan bark, is imported into the United States in large quantities. Bark from the better species of Philippine mangrove trees contains 30 per cent of tannin. A net profit of from $25 (₱50) to $30 (₱60) per ton can probably be made on tanning material derived from the mangrove swamps in the Philippine Islands. Firewood and the products of wood distillation could be made in connection with the cutch industry. The bark of Benguet pine and of palo maria can also be utilized as tanning materials. Forest regulations prevent the cutting of palo maria exclusively for its bark.

Paper pulp.—One of the bamboos, known as caña bojo, has been shown to be especially suitable for the making of paper pulp; it grows in sufficiently large and pure stands to make possible the commercial production of paper pulp. Abacá waste, cogon, talahib, rice straw, etc., are other materials from which the Bureau of Science has made strong paper pulp and which it should be possible to utilize commercially for the same purpose.

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PHILIPPINE BUREAU OF SCIENCE CHART 7

PORTLAND CEMENT, LIME, AND LIME PRODUCTS

[See prints in photograph stand.]

Portland cement.—Imports of Portland cement during recent years have had an average annual market value of about $750,000 (₱1,500,00). The local consumption is certain to increase as the country progresses in financial and industrial importance. The Rizal Cement Company has a small plant at Binangonan. The Bureau of Science has made excellent Portland cement from several local raw materials. In Cebu desirable materials occur adjacent to undeveloped coal fields, the fuel from which is suitable for burning cement.

Lime.—Excellent coralline and crystalline limestone suitable for the manufacture of lime occur throughout the Archipelago, and experiments of the Bureau of Science show that superior lime may be produced from any of these. The lime heretofore produced is of inferior quality, and much of that used for sugar manufacture and for other chemical purposes has been imported. The increased production of sugar by modern methods has so augmented the demand for lime that there is now a need for the output of large kilns. The crude lime of local manufacture sells for as much as $15 (₱30) per ton. This price is sufficient to ensure a handsome profit for good lime. Hydrated lime should find extensive use for road-building and for waterproofing concrete.

Lime products.—In connection with a lime kiln the operation of a bleaching-powder plant and a sand-lime brick plant appear attractive. The value of bleaching powder consumed in Manila alone amounts to $12,500 (₱25,000) per annum. Conditions are favorable in the Philippines for the commercial manufacture of bricks, building blocks, tiles, slabs, and ornamental stones from sand and lime. The cost of manufacture is sufficiently low to enable them to compete with the other building materials.

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PHILIPPINE BUREAU OF SCIENCE CHART 8

PETROLEUM, GAS, COAL, AND ASPHALT

[See prints in photograph stand.]

Petroleum.—The petroleum beds of Bondoc Peninsula, Tayabas Province, Luzon, have been studied by the Bureau of Science and are believed to be worthy of exploration by drilling. Petroleum is known also in Cebu, Iloilo, Capiz, and Leyte Provinces and in Mindanao Island. The oil of Bondoc Peninsula has a paraffin base and is practically free from sulphur.

Gas.—Natural gas occurs with the petroleum and has been encountered also in artesian wells in Albay, Pampanga, and other provinces.

Coal.—Nearly $1,500,000 (₱3,000,000) worth of coal was imported into the Philippine Islands in 1916. Almost every island in the Philippine Archipelago and a majority of the provinces are known to contain coal or lignite. The Bureau of Science has accumulated data concerning the quantity and the quality of the coal in the different fields. Estimates indicate 3,500,000 tons of black lignite and 1,000,000 tons of sub-bituminous coal, while the probable tonnage is: Black lignite, 26,500,000; sub-bituminous, 31,500,000; bituminous or semi-anthracite, 3,500,000. The largest annual (1909) production to date is 30,336 metric tons, valued at $98,592 (₱197,184). Coking-coal occurs in Cebu Province, but the seams have not yet been proved economically important. With Philippine coal the Bureau of Science has been able to produce electric power by means of its 67-horsepower Otto suction producer-gas plant at $0.0165 (₱0.033) per net kilowatt hour.

Asphalt.—Commercial quantities of asphaltic materials exist in Leyte, and some exploratory work has been done on the deposits. There is a great abundance of low-grade material from which high-grade asphalt could be extracted. Various outcrops and seepages of hydrocarbons, ranging from petroleum itself through viscous liquids and semisolids to hard coallike bitumens, are known, and a proper combination of the different materials could no doubt be made to fulfil almost any road conditions.

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Asphalt in Leyte, Bureau of Science press bulletins 42 and 44.

PHILIPPINE BUREAU OF SCIENCE CHART 9

GOLD, SILVER, LEAD, COPPER, AND IRON

[See prints in photograph stand.]

Gold.—The production of gold is steadily increasing. The output in 1916 was worth over $1,650,000 (₱3,300,000).

Silver and lead.—Silver is found alloyed with gold in practically all of the gold deposits in the ratio of 1 part silver to 4 parts gold. Native silver has been reported. Silver is found associated with galena in Bulacan, Paracale, Marinduque, and Mindanao. A newly discovered 2-meter vein of comparatively pure galena has been recently opened in Marinduque and is said to be extensive.

Copper.—Copper deposits are known to exist in several provinces. The deposits at Mancayan, Mountain Province, Luzon, have been worked for years, and large amounts of high-grade ore have been taken out. According to reports of various examining engineers there are 500,000 tons of available ore, averaging 2.5 per cent. Other copper deposits have been found in Benguet, Pangasinan, Batangas, Mindoro, Masbate, Panay, and Mindanao. The deposit in Pangasinan is being explored at the present time.

Iron.—There are valuable deposits of iron ore in the Philippines, some of them exceedingly well located for an economic handling of the ore. A lack of proper smelting facilities has prevented their exploitation on a large scale, but many small iron castings are produced each year in native furnaces.

A deposit high-grade hematite ore is available in Ambos Camarines and in Bulacan. An unworked laterite iron-ore deposit in Surigao, Mindanao, has been examined by Bureau of Science engineers, who estimate it to contain over 500,000,000 metric tons of available ore averaging from 45 to 50 per cent iron. The deposit is located near a good harbor, and the ore could be loaded with steam shovels at a low cost. Other valuable deposits occur, but no detailed examination of them have been made.

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PHILIPPINE BUREAU OF SCIENCE CHART 10

MINOR MINERAL RESOURCES

[See prints in photograph stand.]

Asbestos.—Asbestiform minerals are widespread in the Philippines. They occur associated with serpentine, which has been found in Ilocos Norte, Bataan, Antique, and Albay Provinces, Luzon.

Manganese.—Manganese occurs as psilomelane, pyrolusite, and wad in Ilocos Norte, Pangasinan, Bulacan, Tarlac, and Masbate. Three thousand tons of manganese were mined in Ilocos Norte and shipped to Japan in 1916.

Guano and phosphates.—Bat guano occurs in caves in nearly every province. Much of this is valuable as a fertilizer, and it has been used to great advantage on sugar cane fields. The guano can be delivered to any plantation for a fraction of the cost of commercial fertilizers. One planter in the Silay district, Negros, increased his crop nearly 100 per cent by the use of guano. An area of leucite-tephrite, a potash-bearing rock, which may some time become a source of potash, has been discovered and mapped near Aroroy, Masbate, by the Bureau of Science. Apatite, a calcium phosphate, found in Ilocos Sur, may indicate a commercial source of phosphates.

Salt.—The salt manufactured in the Philippine Islands each year is valued at more than $250,000 (₱500,000). Sea water evaporated by solar heat is the source of the larger part of this production, but in certain localities, notably north-central Luzon, brine from salt springs is utilized.

Other Philippine mineral resources are fire clay, abrasives, alum, artesian and mineral waters, gems, and gypsum.

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PHILIPPINE BUREAU OF SCIENCE CHART 11

FISHES

[See prints in photograph stand.]

Market fishes.—Two thousand five-hundred dollars' (₱5,000) worth of fish are sold daily in the Manila markets. A large part of these is bañgos (*chanos chanos*), which is artificially propagated in large ponds in the vicinity of Manila. Philippine waters abound in excellent food and game fishes. During calm weather they are taken by fishermen in small craft. There are no trawlers operating.

Sardines.—Such fishes as sardines, anchovies, and herrings exist in the Philippine Islands in large numbers and constitute a potential source of wealth. Nearly all of those caught are consumed fresh or are poorly preserved with salt. When these fishes are properly canned, the product is equal to the best in the market. Great improvement could be made in the salting of other classes of fishes. There is an abundant local supply of salt. The opportunity for a sardine cannery seems promising.

Introduced fishes.—The small-mouthed black bass (*Micropterus salmoides*) has been successfully introduced from the United States and is established at several points in the Islands.

REFERENCES

A check-list of Philippine fishes, Bureau of Science publication No. 1. Philippine commercial fishes, Philippine Journal of Science, Sec. A (1908), vol. 3, No. 6, 513–531. New species of Philippine fishes, Phil. Journ. Sci., Sec. A (1909), vol. 4, No. 6, 491–543; Sec. D (1910), vol. 5, No. 2, 115–119. The successful transference of black bass into the Philippine Islands, with notes on the transportations of live fish long distances, Phil. Journ. Sci., Sec. D (1910), vol. 5, No. 3, 153–159. Miscellaneous marine products of the Philippine Islands, Phil. Journ. Sci., Sec. D (1911), vol. 6, No. 6, 283–320. Food fishes and sharks of Mindanao and Sulu, Phil. Journ. Sci., Sec. D (1916), vol. 11, No. 3, 235–243. Fishery resources of Mindanao and Sulu, Bureau of Science press bulletin 34.

PHILIPPINE BUREAU OF SCIENCE CHART 12

PRODUCTS FROM MARINE SHELLS

[See prints in photograph stand.]

Pearls.—The pearling industry is well established in the southern part of the Philippine Archipelago. Pearls valued at about $500,000 (₱1,000,000) are exported from Zamboanga each year.

Pearl shells.—The annual catch of pearl shells is valued at approximately $350,000 (₱700,000).

Button shells.—The top shell (Trochus) and the turban shell (*Turbo*) are gathered for the manufacture of buttons. They are used locally or exported.

Window shells.—Window shells are used locally in the place of window glass. They can be made into attractive screens and lamp shades.

REFERENCES

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tayan, Phil. Journ. Sci., Sec. D (1910), vol. 5, No. 3, 149–151. Pearl, pearl shells, and button shells of Mindanao and Sulu, Phil. Journ. Sci., Sec. D (1916), vol. 11, No. 4, 245–265.

Miscellaneous marine products of the Philippine Islands, Phil. Journ. Sci., Sec. D (1911), vol. 6, No. 6, 296–305.

PHILIPPINE BUREAU OF SCIENCE CHART 13

MINOR MARINE PRODUCTS

[See prints in photograph stand.]

Sponges.—There are several valuable varieties of sponges in Philippine waters. They should be cured only by experienced men.

Tortoise shell.—Most of the Philippine catch of tortoise shell is exported. A small amount is manufactured locally into small articles. The export in 1913 was valued at about $18,000 (₱36,000).

Trepang.—The annual export of trepang is worth about $65,000 (₱130,000). Methods of drying could be improved, and the industry could be increased.

Coral.—Small pieces of the precious red coral have been found in Philippine waters, and a blue coral occurs which might be made into jewelry. Many kinds of white coral are abundant.

Oysters.—Oysters of good quality grow readily in the many tidal streams about Manila. The industry could be greatly increased.

REFERENCES

Sponge and sponge fisheries of the Philippine Islands, Philippine Journal of Science, Sec. A (1909), vol. 4, No. 1, 57–65. Sponges of Mindanao and Sulu (in manuscript).

Philippine tortoise shell, Phil. Journ. Sci., Sec. D (1911), vol. 6, No. 6, 291–295.

Philippine trepang, Phil. Journ. Sci., Sec. D (1911), vol. 6, No. 6, 283–289.

Philippine shark fin, Phil. Journ. Sci., Sec. D (1911), vol. 6, No. 6, 289–291.

Philippine corals, Phil. Journ. Sci., Sec. D (1911), vol. 6, No. 6, 305–308.

PHILIPPINE BUREAU OF SCIENCE CHART 14

BUREAU OF SCIENCE AQUARIUM AND MAIN BUILDING

[See cards in large frame and prints in photograph stand.]

Bureau of Science aquarium.—The aquarium of the Bureau of Science is situated in Manila on Calle Gral. Luna within the bastion of Puerto Real of the old city wall. The building is a substantial one-story structure of reënforced concrete. It consists of a single corridor or tunnel, 85 meters long and 8 meters wide. There are twenty-seven exhibition tanks, each of which is faced with 1-inch plate glass. The tanks are lighted by skylights, and the backs of the tanks slope, so that there is no unlighted corner. Practically all of the light in the corridor comes through the tanks. Two large tanks outside of the corridor, each about 12 meters in diameter, afford accommodation for crocodiles, sharks, and turtles. In the Bureau of Science aquarium there is at all times an interesting display of bright-colored and curious fishes, sea anemones, crabs, sea urchins, star-fishes, and other sea animals found in the waters of the Philippine Islands.

Main building of the Bureau of Science.—The main building of the Bureau of Science was completed in 1905. A reënforced concrete wing was added in 1911. The building houses all Government laboratories and the Bureau of Science library, which is the scientific branch of the Philippine Library. The scientific library contains about 35,000 bound volumes and about 20,000 unbound volumes and pamphlets. Some of the activities of the Bureau of Science are: The testing of cements, road-metals, and other construction and commercial materials; the bacteriological, pathological, and diagnostic work in connection with the detection and the control of diseases of man and of domestic animals; the biological and chemical examination of artesian-well and other waters; the preparation and sale of serums and vaccines; the investigation of fungi and the diseases produced by them; in charge of the Government herbarium of Philippine and Far Eastern flora, the investigation of economically valuable plants, and other botanical work; the collection of fish and marine animals, the development of the sponge, shark fin, trepang, and other sea-products industries, and the stimulation of the food-fish industry; the collection of birds and other natural history specimens, a study of the relation of birds to the control of insect pests, and the performance of other, similar zoölogical work; in charge of the construction and equipment of all Government laboratories in the Philippine Islands and of the standardization of instruments of precision, of measure, and of solutions for the Philippine Government; analyses of mineral products, soils, fertilizers, minero-medicinal waters, etc.; analyses of coals; analyses under the Pure Food and Drugs Act; investigations into quality, composition, or properties of articles of food and drink, of gums, resins, drugs, herbs, oils, and other plant products; investigations into the mineral and engineering surveys of mines; the Iloilo sugar laboratory and investigations into the quality of, and the means of improving, Philippine sugars, and the encouragement of Philippine industries generally; special investigations needed by the Insular Government which may require laboratory facilities or scientific knowledge of a specialized character; etc.

Publications.—The results of the work and investigation of the Bureau of Science are made available in the following series of publications which represent the Bureau of Science before the world:

The Philippine Journal of Science.
The Mineral Resources of the Philippine Islands.
Annual Report of the Director of the Bureau of Science.
Bureau of Science publications (monographs).
Bureau of Science press bulletins.

PHILIPPINE BUREAU OF SCIENCE CHART 15

BIRDS AND INSECTS AND THEIR PRODUCTS

[See prints in photograph stand.]

Birds.—There are about 750 species of birds known in the Philippine Islands. Among the important game birds may be mentioned: The jungle fowl, the peacock pheasant, rails, snipe, plovers, godwits, curlews, ducks, and many species of doves. The edible-nest swift is found throughout the Islands. The nests of this bird are collected and exported.

Bees.—Wild bees are plentiful in all of the wooded portions of the Philippines. There is a considerable local trade, excellent honey and wax being

collected by the crudest methods. Domesticated bees have been imported. Apiculture has not been developed, but could be carried on in connection with farming to the extent of excluding imported honey.

Silkworms.—The Bureau of Science has introduced silkworms into the Philippine Islands and has developed a hybrid which yearly has nine generations. Silkworms are not attacked by disease in the Philippines. Their food, the mulberry, grows most luxuriantly in all parts of the Islands and is free from pests. A hectare (2.47 acres) (of 1,100 trees) will feed about three million silkworms per annum, and leaves may be harvested at the end of two years after cuttings have been planted. There is an excellent market for all the silk that can be produced.

REFERENCES

A manual of Philippine birds, Bureau of Science publication No. 2. Birds in their economic relation to man through agriculture and forestry, Bureau of Science press bulletin 32. Birds in their economic relation to man, Bureau of Science press bulletin 32, revised.

A manual of Philippine silk culture, Bureau of Science publication No. 4. Planting and care of mulberry trees, Bureau of Science press bulletin 55.

PHILIPPINE BUREAU OF SCIENCE CHART 16

TOBACCO

[See prints in photograph stand.]

About one-quarter billion cigars worth $5,000,000 (₱10,000,000), of which 5 per cent are exported to the United States, are manufactured in the Philippine Islands annually. About four and one-quarter billion cigarettes are manufactured annually. It has been demonstrated by the Bureau of Science that 100 per cent immunity from the cigarette beetle, which has caused Philippine cigars to be rejected in the European and American markets, can be assured, if the manufacturer will properly protect his stock of raw and prepared tobacco while in the factory.

REFERENCES

Problems in economic entomology in the Philippines, Philippine Journal of Science (1906), vol. 1, No. 10. The cigarette beetle (*Lasioderma serricorne* Fabr.) in the Philippine Islands, Phil. Journ. Sci., Sec. D (1913), vol. 8, No. 1, 1–42.

The cigarette beetle as a destroyer of tobacco, Bureau of Science press bulletin 30. The molds of cigars and their prevention, Bureau of Science press bulletin 31.

PHILIPPINE BUREAU OF SCIENCE CHART 17

PHILIPPINE FIBERS AND TIE MATERIALS

[See prints in photograph stand.]

Abacá (Manila hemp).—Abacá is the most important fiber and export product of the Philippine Islands. In 1916 abacá comprised 40 per cent of the total exports and was about 140,000,000 kilograms valued at $26,700,000 (₱53,400,000). The purchaser is now protected in the materials which he purchases due to Government supervision of grading.

Maguey.—Frequently maguey and other fibers are cheaper than abacá (Manila hemp) and are as satisfactory for many purposes. The export of

maguey from the Philippine Islands in 1916 was valued at over $1,700,000 (₱3,400,000).

Buntal fiber and other hat materials.—The fiber extracted from the petioles of the buri palm is used for making the buntal hats, one of the best hats of the Philippine Islands marketed in the United States as Bankok hats. Fine hats made from bamboo fibers are marketed under the name of Batavia hats. The present method of extracting the buntal fiber is slow and expensive. The Bureau of Science has improved the method, with the result that the cost of extracting the fiber may be much reduced and should not only cheapen this hat of superior quality, but make possible the use of buntal fiber in other countries. Several fibers are used in the manufacture of high-grade hats, similar to the Panama hat. Hats made from buri palm leaves are cheaper and better than the cheap straw hats sold in the United States. Abacá affords an abundant supply of excellent raw material which is woven into women's hats.

Rattans.—The commercial rattans of the Philippine Islands are derived from the climbing palms. The many species in the Philippine Islands belong to three genera. Some of these are small, the canes being 1 centimeter or less in diameter, while others have a diameter of 5 centimeters. The stripped material of some species is very tough; it has great tensile strength, does not readily break in bending, and can be readily bleached. As soon as the material can be satisfactorily separated into definite grades and the differences which control the commercial product determined, there is no reason why a considerable export trade of Philippine materials should not be developed.

Bast fibers.—Bast fiber is a tough, fibrous layer between the wood and the bark, which is characteristic of certain families of plants, some of which are represented in the Philippine Islands by numerous species. Among these are various species of trees, known as "banot" (genus *Sterculia*) and "analao" (genera *Grewia* and *Columbia*), and certain small shrubs, known as "anabo" (genus *Abroma*). These bast fibers have an extensive local use as a substitute for abacá, and in some parts of the Islands, for example, the Ilocano provinces, the making of rope from bast fibers has a considerable commercial importance. Some of the bast-fiber ropes are superior in durability to abacá rope when much exposed to moisture.

Kapok.—Tree cotton, while of too short fiber to be of use as a textile material, is a superior filling for pillows and mattresses. The fibers are oily and, therefore, do not become easily water-soaked. For this reason kapok is a suitable filler for life-preservers.

Cotton.—True cotton is cultivated and made into various articles for local use.

Cloths.—Some of the above-enumerated fibers and especially the fiber of the pineapple are manufactured into cloth for which there is a certain export demand. Cloth known as piña made from the pineapple fiber is very similar to very fine linen and is used especially in making fine embroidery. Sinamay made from abacá is similar to crinoline and is used for similar purposes. The so-called Ilocano cloth made from cotton is characteristic on account of the weave and the dyeing and is much sought for and popular for curtains, pillow covers, etc.

REFERENCES

Philippine hats, Philippine Journal of Science, Sec. C (1911), vol. 6, No. 2, 93–131.

The charts are illustrated by well-arranged photographs mounted in a photograph stand. A complete file of the Philippine Journal of Science, Mineral Resources of the Philippine Islands, and various miscellaneous publications has been placed on file in the New York office of the Philippine National Bank.

RECOMMENDATIONS

During the past calendar year we have had available for the work of the Bureau of Science ₱371,976. This amount is too small to perform most efficiently the work which the Bureau of Science should do, and many constructive problems remain untouched. An increased appropriation, if judicially handled, would yield more than proportional returns on the investment. Practically all of my recommendations for the last four years remain unacted upon. Because of lack of funds the legislature has made no appropriations for the extension of any work in the Bureau of Science. In the past only a very few legislators have shown a desire to ascertain how the Bureau of Science could become of greatest value to the Philippine Islands. With a permanent legislative body and an increased interest in the development of natural resources it is hoped that my recommendations of former years may receive careful consideration. The need for all classes of scientific work is increasing, and their value is being much more recognized and appreciated. The extension of publicity propaganda along all scientific lines is badly needed as indicated on page 19. In practically every branch of its activities the Bureau of Science needs more scientific employees to keep up with the regular work of the institution, to do the work requested, to be ready to supply desired information, and to answer questions when they arise.

The Bureau especially needs an entomologist. None is on duty at present, and the available position was abolished by the legislature. Also, as already pointed out under entomology, this institution should employ an expert sericulturist. The rearing of silkworms seems admirably adapted to this country, but there must be careful selection of stock, skillful rearing, and a good name developed for Philippine silk. For such work a silk expert is urgently needed.

Work on the Bureau of Science medicinal plant survey of the Philippines should be prosecuted vigorously, and this can be done most successfully only by close coöperation of the botanist, the organic chemist, the pharmaceutical chemist, and the physicians. The chemist at present assigned to this work can carry it on only when he is free from routine, whereas his major work

should be on the promising medicinal and poisonous plants that have not as yet been subjected to any investigation. The field here is almost unlimited, and a critical study is certain to yield much of interest and value.

The work of the sera and vaccines laboratory could be greatly facilitated by increased stable accommodations and a larger paddock. A modern operating room also should be provided. I believe there is opportunity for the commercialization of this work in the Philippine Islands if proper facilities are provided.

The field survey of Philippine water supplies described on pages 31 and 32 is a most important piece of work and should be greatly extended. Few countries are better adapted climatically for carrying on field work, and in few countries is such work more necessary or more capable of producing beneficial results. The present personnel is insufficient to do the work which should be done.

The herbarium collections are now housed in the fire-proof east wing of the Bureau of Science building and, from the standpoint of safety, are well protected. However, the present quarters are inadequate, involving much loss of time in consulting the collections, a difficulty that will increase rather than decrease. The preparation of adequate properly arranged quarters for this valuable botanical collection should be made. The constant addition of books to the library will necessitate additional space, which could be readily arranged for by the allotment of that now occupied by botany.

Almost every section of the Bureau has inadequate laboratory space, and chemists and others are working in crowded rooms. The quarters for the testing of structural and other materials, such as cement, reënforcing iron, steel, rope, wire, road materials, tiles, cement pipes, concrete, mortar, building blocks, bricks, stone, cloth, etc., are much too small. The city of Manila is most anxious that the Bureau of Science make the regular tests of the gas supplied by the Manila Gas Corporation under the municipal ordinance, but there is no space available for this purpose. There is no adequate protection for the consumer without such tests. The need for greater space could be met by the erection of a wing on the west end of the main building corresponding to the one on the east end.

I desire to renew my recommendation of last year that the Government aid in sending the more advanced Bureau of Science library assistants to the United States for further professional training, in order that we may have available a group of trained

employees for carrying on library work of a high order and for teaching in the library training courses.

The Liga Nacional Filipina para la Proteccion de la Primera Infancia in its report submitted on October 15, 1916, says: "We believe it our duty to call the attention of the Philippine Legislature to the small sum of ₱1,706.22, which is all that remains of the amount appropriated by Act No. 2376, and this is insufficient for the production of the necessary amount of tiqui-tiqui extract during next year. We recommend that beginning with 1917 a sum of not less than ₱2,000 be appropriated annually for the manufacture by the Bureau of Science of extract on a large scale * * *.[1] As shown on page 16 the preference of the "Liga" and other agencies for the extract made by the Bureau of Science is a commendable appreciation of the quality of our product. Since the above-quoted report was written, the "Liga" has taken steps toward extending its activities in the provinces, and the sum mentioned above should be probably doubled. It is recommended that the tiqui-tiqui plant be enlarged in order that no request for this extract need be refused. Provision should be made whereby all legitimate requests for the extract can be complied with by the Bureau of Science.

Tables showing the routine work performed and supplies manufactured and disposed of during the calendar year 1916 by the Bureau of Science, and the financial statement showing the appropriation and how it was expended, are attached hereto.

Respectfully submitted.

ALVIN J. COX,
Director, Bureau of Science.

To the Honorable
The SECRETARY OF THE INTERIOR.

[1] Translated from the Spanish.

TABLE I.—*Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1916, as compared with the fiscal year 1915, by number or quantity and by value, arranged by subdivisions of the Bureau of Science.*

Subdivision of the Bureau of Science.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1915	1916	1915	1916	1915	1916
General, inorganic, and physical chemistry:						
Metals and alloys	44	25	18	24	243.00	144.00
Rocks, minerals, natural pigments, and similar substances	15	71		68		475.00
Clays, shales, limestones, limes, wall plasters, cement, and slags	5	10	2	2	28.00	23.00
Fertilizers	34	72	22	34	246.20	329.00
Soils and similar substances	365	18		3		25.00
Coal analyses	50	10	49	6	385.40	155.00
Calorimetric tests of fuels	34	7	34	3	672.00	96.00
Paints and varnishes		14		14		184.00
Waters	201	202	32	15	611.50	294.00
Crude chemical and miscellaneous analyses	135	166	115	157	497.00	499.00
Standard solutions (in liters)	20	304	2	45	9.00	89.99
Physical test of wire, twine, fiber, textile, paper, and similar articles	32	4	32	3	87.00	12.00
Cements	6,716	15,790	6,696	15,676	9,427.15	12,015.80
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc.	203	468	203	457	635.40	482.75
Standardization of road materials	71	67	71	67	467.40	410.10
Standardization of units of measure:						
Lengths	60	679	60	679	6.00	•247.75
Capacities	121	56	121	56	27.10	83.60
Weights	31	20	31	20	16.95	23.85
Miscellaneous	22	79	22	78	15.50	162.10
Total	8,159	18,062	7,510	17,407	13,374.60	15,751.94
Organic chemistry:						
Urines, clinical and toxicological analyses	192	196	80	110	274.00	393.00
Essential oils and essences	11	10	11	10	77.50	71.00
Petroleum and products, copra, and similar materials	20	60	10	36	98.00	461.50

TABLE I.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Subdivision of the Bureau of Science.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1915	1916	1915	1916	1915	1916
Organic chemistry—Contd.						
Linseed oils	63	17	54	6	412.65	103.00
Gums, resins, and similar materials	1	2	1	2	5.00	20.00
Paper and similar materials	117	135				
Gastric juice, clinical examinations	2	5	2	2	95.00	8.00
Foods and alcohols and beverages	2,921	1,164	245	123	951.20	147.67
Food preservatives and coloring matters	25	27	15		89.00	
Medicines and similar articles	120	120	24	54	485.00	651.60
Miscellaneous chemical analyses and examinations	178	25	36	16	298.04	122.00
Total	3,650	1,761	478	359	2,785.39	1,977.77
Mines:						
Assays	677	518	650	507	957.76	1,341.50
Biological laboratory:						
Fæces	50,021	266,676	1,118	171	3,352.33	427.00
Sputum	85	330	21	46	63.00	138.00
Blood	29	47	22	22	210.00	148.00
Culture	2	4	2	4	10.00	25.00
Widaltest	5,166	615	6	2	18.00	6.00
Wassermann test	633	1,689	257	239	2,502.88	2,390.00
Leprosy	569	555		1		3.00
Urines	2	5	1		25.00	
Gonococci	15,832	17,169	10	32	30.00	96.00
Waters	2,986	4,108	11	12	350.00	309.00
Necropsies	117					
Histological examinations	473	7	13		130.00	60.00
Rabies	21	18				
Plague	1					
Rats for plague	79,298	69,556				
Miscellaneous biological examinations	10,035	4,866	9	13	48.00	94.00
Total	165,270	365,645	1,470	548	6,739.21	3,696.00

TABLE I.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Subdivision of the Bureau of Science.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1915	1916	1915	1916	1915	1916
Serum section of the biological laboratory:						
Vaccine virus (doses)	1,788,666	1,523,703	1,788,666	1,523,703	18,976.60	17,417.80
Mallein (doses)	10	707	10	707	10.00	707.00
Miscellaneous sera and preparations (cubic centimeters)	9,520,841	2,720,437	5,208,940	2,720,437	12,785.00	8,316.67
Total	6,997,617	4,244,847	6,997,616	4,244,847	31,771.60	26,441.47
Miscellaneous:						
Photographs	4,971	4,916	4,020	3,500	1,403.60	1,275.45
Natural history specimens	82	24	82	24	208.48	451.38
Shop work	182	337	20	13	135.32	69.88
Miscellaneous work	17	69	17	69	5,249.94	8,343.44
Supplies		1,146		1,146		1,867.46
Sales of publications					4,548.99	3,551.42
Refunded work not done, etc. (deducted)					(102.50)	(202.61)
Power, gas, etc					31,125.23	16,769.98
Total	5,252	6,492	4,139	4,752	42,569.06	32,126.40
Grand total	7,180,625	4,637,325	7,011,863	4,268,420	98,197.62	1,335.08

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1916, as compared with the fiscal year 1915, by number or quantity and by value, arranged with reference to Government and other patronage.*

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1915	1916	1915	1916	1915	1916
Bureau of Agriculture:						
Fertilizers	9	38				
Soils and similar substances	363	13				
Crude chemical and miscellaneous analyses	1	5		3		3.00
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc.		3		3		3.00
Foods and alcohols and beverages	29	34				
Miscellaneous chemical analyses and examinations	123					
Standard solutions	1		1		5.00	
Photographic work	16	2	16	2	11.09	1.80
Total	542	95	17	8	16.09	7.80
Bureau of Civil Service:						
Photographic work		85		85		17.00
Bureau of Coast and Geodetic Survey:						
Gonococcus		1				
Vaccine virus		100		100		1.00
Miscellaneous sera and preparations	320	90	320	90	128.00	36.00
Total	320	191	320	190	128.00	37.00
Bureau of Customs:						
Metals and alloys	4					
Waters, chemical	1					
Waters, biological	51	80				
Petroleum and products, copra, and similar materials	1	1				
Linseed oils	1	1	1		4.00	
Medicines and similar articles	9	1				
Fæces		45				
Sputum		1				
Rabies		1				
Miscellaneous biological work and examinations		1				
Total	67	131	1		4.00	

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1915	1916	1915	1916	1915	1916
Bureau of Education:						
Fertilizers	2					
Foods and alcohols and beverages	1					
Photographic work		28		28		24.30
Supplies		7		7		26.00
Total	3	35		35		50.30
Executive Bureau:						
Soils and similar substances		2				
Photographic work	625	253	625	253	182.24	44.37
Total	625	255	625	253	182.24	44.37
Bureau of Forestry:						
Soils and similar substances	2					
Photographic work	156	188	156	188	33.99	28.56
Total	158	188	156	188	33.99	28.56
Philippine Health Service:						
Metals and alloys	1					
Clays, shales, limestones, limes, wall plasters, cements, and slags		1				
Waters, chemicals	14	7				
Waters, biological	1,062	2,862				
Crude chemical and miscellaneous analyses	6	1				
Cements		11		11		18.00
Fertilizers	1					
Urines, clinical and toxicological analyses	107	85				
Petroleum and products, copra, and similar materials	2	4				
Linseed oils	5	1				
Gastric juice, clinical examinations		2				
Foods and alcohols and beverages	2,597	957				
Food preservatives and coloring matters	10	27				
Medicines and similar articles	73	52				
Miscellaneous chemical analyses and examinations	2	7		2		4.10
Fæces	20,262	140,484				
Sputum	61	279				

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1915	1916	1915	1916	1915	1916
Philippine Health Service—Continued.						
Blood	7	21				
Widal test	5, 152	613				
Wassermann test	283	127				
Leprosy	569	552				
Urines	1	5				
Gonococci	15, 822	17, 136				
Necropsies	102					
Histological examinations	457	1				
Rabies	21	17				
Plague	1					
Rats for plague	79, 032	69, 221				
Miscellaneous biological work and examinations	10, 021	4, 811				
Vaccine virus	1, 726, 560	1, 359, 700	1, 726, 560	1, 359, 700	17, 265. 60	13, 597. 00
Miscellaneous sera and preparations	3, 535, 510	1, 562, 011	3, 535, 510	1, 562, 011	8, 141. 22	2, 759. 64
Photographic work	180	279	180	279	102. 74	144. 12
Shop work	1		1		8. 66	
Total	5, 397, 922	3, 159, 274	5, 262, 251	2, 922, 003	25, 518. 22	16, 522. 86
Bureau of Internal Revenue:						
Standardization of weights	7	2	7	2	2. 45	5. 00
Urines, clinical and toxicological analyses	1					
Foods and alcohols and beverages		8				
Medicines and similar articles	9	7				
Petroleum and products, copra, and similar materials	1					
Photographic work		161		161		85. 45
Total	18	178	7	163	2. 45	90. 45
Bureau of Justice:						
Gastric juice, clinical examinations	2		2		95. 00	
Urines, clinical and toxicological analyses	1		1		20. 00	
Medicines and similar articles	14	46	14	46	140. 00	460. 00
Blood	2	1	2	1	150. 00	75. 00
Total	19	47	19	47	405. 00	535. 00

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1915	1916	1915	1916	1915	1916
Philippine Constabulary:						
Physical test of wire, twine, fiber, textile, paper, and similar articles	1		1		4.00	
Leprosy		2				
Miscellaneous biological work and examinations		1				
Vaccine virus	2,650	1,300	2,650	1,300	26.50	13.00
Miscellaneous sera and preparations	6	3,030	6	3,030	3.00	54.00
Photographic work	2		2		3.20	
Total	2,659	4,333	2,659	4,330	36.70	67.00
Philippine Exposition Board:						
Photographic work	49		49		140.00	
Bureau of Printing:						
Paper and similar materials	117	135				
Medicines and similar articles	2	1				
Linseed oils		1				
Total	119	137				
Bureau of Prisons:						
Gastric juice		1				
Medicines and similar articles		1				
Fæces	26,927	112,216				
Sputum	1					
Widal test	8					
Wassermann test	93	1,323				
Necropsies	15					
Histological examinations	3					
Waters, biological		9				
Miscellaneous biological work and examinations	5	31				
Photographic work		98		98		119.53
Total	27,052	113,679		98		119.53
Bureau of Public Works:						
Metals and alloys	3		3		29.00	
Crude chemical and miscellaneous analyses	6	19		19		57.00
Standard solutions (in liters)		87		11		20.87
Cements	2,014	1,692	2,014	1,692	3,257.10	2,936.60

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1915	1916	1915	1916	1915	1916
Bureau of Public Works—Ctd.						
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc.	6	110	6	110	24.00	121.95
Standardization of road materials	5	5	5	5	26.00	25.00
Paints and varnishes	8	2	8	2	94.50	36.00
Petroleum and products, copra, and similar materials	3					
Waters, chemical	146	139				
Waters, biological	106	26				
Photographic work	16		16		5.30	
Physical test of wire, twine, fiber, textile, paper, and similar articles	3		3		13.00	
Shop work	1		1		18.00	
Total	2,317	2,080	2,056	1,839	3,466.90	3,197.42
Bureau of Quarantine Service:						
Urines, clinical and toxicological analyses	1					
Fæces	1,693	13,517				
Sputum	2					
Rats for plague	266	335				
Vaccine virus	9,400	9,000	9,400	9,000	94.00	90.00
Photographic work		30		30		49.30
Total	11,362	22,882	9,400	9,030	94.00	139.30
Bureau of Science:						
Metals and alloys	20					
Rocks, minerals, natural pigments, and similar substances	15	2				
Clays, shales, limestones, limes, wall plasters, cement and slags	3	5				
Coal analyses	1	2				
Calorimetric tests of fuels		4				
Crude chemical and miscellaneous analyses	7	5				
Standard solutions (in liters)	18	183				
Cements	20	114				

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1915	1916	1915	1916	1915	1916
Bureau of Science—Contd.						
Compression, tensile, or transverse strength of concrete, stone mortar, rope, iron and steel, etc.		2				
Petroleum and products, copra, and similar materials	2	4				
Urines, clinical and toxicological analyses		1				
Linseed oils	1	2				
Miscellaneous chemical analyses and examinations	6	2				
Waters, chemical	1	14				
Waters, biological	733	372				
Assays		5				
Miscellaneous biological work and examinations		4				
Miscellaneous sera and preparations	1					
Assays	27					
Photographic work	951	1,416				
Shop work	162	324				
Total	1,968	2,461				
Bureau of Supply:						
Metals and alloys	1	1				
Crude chemical and miscellaneous analyses		2		1		5.00
Standard solutions (in liters)	1	1	1	1	4.00	0.62
Physical tests of wire, twine, fibers, textiles, paper, and similar materials	10	1	10		31.00	
Cements	3,788	13,662	3,788	13,662	3,522.40	7,926.85
Paints and varnishes		7		7		120.00
Standardization of units of measures:						
Lengths	60	679	60	679	6.00	247.75
Capacities	121		121		27.10	
Weights	24	12	24	12	14.50	9.85
Miscellaneous	21	1	21		10.50	
Petroleum and products, copra, and similar materials	1	15				
Linseed oils	36	6	33		172.75	
Foods and alcohols and beverages	49	42				

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1915	1916	1915	1916	1915	1916
Bureau of Supply—Contd.						
Medicines and similar articles	3	4				
Miscellaneous chemical analyses and examinations	7					
Waters, chemical	7	17				
Waters, biological	11	15				
Miscellaneous biological work and examinations		5				
Miscellaneous sera and preparations	10,064	23	10,064	23	45.60	9.70
Supplies		1		1		4.00
Total	14,204	14,494	14,122	14,386	3,833.85	8,323.77
University of the Philippines:						
Miscellaneous chemical analyses and examinations	1		1		18.34	
Fæces	21	243				
Miscellaneous sera and preparations		32,060		32,060		34.00
Photographic work	531	251	531	251	122.20	82.52
Shop work	3	1	3	1	24.84	8.27
Supplies		56		56		3.05
Total	556	32,611	535	32,368	165.38	127.84
City of Manila:						
Clays, shales, limestones, limes, wall plasters, cements, and slags		1		1		8.00
Crude chemical and miscellaneous analyses	35	6	35	6	43.00	78.00
Standard solutions (in liters)		13		13		48.50
Cements	108	82	108	82	416.35	308.70
Standardization of road materials		2		2		25.00
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	12	10	12	7	11.00	14.00
Linseed oils		1		1		18.00
Miscellaneous chemical analyses and examinations	7		3		75.00	
Waters, biological	1,012	741				
Miscellaneous biological work and examinations	4		4		20.00	
Blood		4				

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Costumer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1915	1916	1915	1916	1915	1916
City of Manila—Continued.						
Miscellaneous sera and preparations	168,532	150,001	168,532	150,001	200.50	152.40
Total	169,710	150,867	168,694	150,113	765.85	652.60
Provinces and municipalities:						
Metals and alloys		4		4		28.00
Crude chemical and miscellaneous analyses	6	16	6	16	29.50	252.00
Cements	510	23	510	23	668.00	201.65
Clays, shales, limestones, limes, wall plasters, cements, and slags		3		1		15.00
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	60	323	60	323	403.40	310.80
Coal analyses		1		1		35.00
Standardization of road materials	60	54	60	54	403.40	290.60
Medicines and similar articles		3		3		70.00
Waters, chemical		2		1		6.00
Vaccine virus	30,000	80,000	30,000	80,000	900.00	2,400.00
Miscellaneous sera and preparations		53,525		53,525		1,559.74
Photographic work	198		198		66.75	
Paints and varnishes	2	1	2	1	31.00	8.00
Total	30,836	133,955	30,836	133,952	2,502.05	5,176.79
United States Army and Navy:						
Metals and alloys	4	1	4	1	40.00	24.00
Coal analyses	43		43		293.40	
Calorimetric tests of fuels	23		23		352.00	
Waters, chemical	1		1		40.00	
Waters, biological	2		2		80.00	
Physical tests of wire, twine, fibers, textiles, paper, and similar articles	8		8		12.00	
Cements	61	48	61	48	328.50	240.00
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	13	6	13	6	22.00	19.00

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1915	1916	1915	1916	1915	1916
United States Army and Navy—Continned.						
Crude chemical and miscellaneous analyses	1	5	1	5	5.00	36.00
Urines, clinical and toxicological analyses	----------	1	----------	1	----------	50.00
Standardization of units of measures	1	6	1	6	5.00	9.00
Petroleum and products, copra, and similar materials	1	3	1	3	15.00	83.00
Linseed oils	2	3	2	3	30.00	45.00
Foods and alcohols and beverages	6	5	6	5	78.00	50.00
Miscellaneous biological work and examinations	----------	1	----------	1	----------	3.00
Vaccine virus	18,330	21,410	18,330	21,410	588.50	685.00
Mallein	10	707	10	707	10.00	707.00
Miscellaneous sera and preparations	767,744	448,927	767,744	448,927	1,763.80	1,620.85
Supplies	----------	253	----------	253	----------	77.45
Total	786,250	471,376	786,250	471,376	3,663.20	3,649.30
Miscellaneous:						
Metals and alloys	11	19	11	19	174.00	92.00
Clays, shales, limestones, limes, wall plasters, cements, and slags	2	----------	2	----------	28.00	----------
Rocks, minerals, natural pigments, and similar substances	----------	69	----------	68	----------	475.00
Fertilizers	22	34	22	34	246.20	329.00
Soils and similar substances	----------	3	----------	3	----------	25.00
Coal analyses	6	7	6	5	92.00	120.00
Calorimetric tests of fuels	11	3	11	3	320.00	96.00
Crude chemical and miscellaneous analyses	73	107	73	107	419.50	68.00
Paints and varnishes	----------	4	----------	4	----------	20.00
Physical tests of wire, twine, fibers, textiles, paper, and similar articles	10	3	10	3	27.00	12.00
Standard solutions (in liters)	----------	20	----------	20	----------	20.00
Cements	215	158	215	158	1,234.80	384.00

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1915	1916	1915	1916	1915	1916
Miscellaneous—Continued.						
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	112	8	112	8	175.00	14.00
Standardization of road materials	6	6	6	6	38.00	69.50
Standardization of units of measures (capacities)		56		56		83.60
Miscellaneous inorganic analyses		78		76		158.00
Urines, clinical and toxicological analyses	82	109	79	109	254.00	343.00
Essential oils and essences	11	10	11	10	77.50	71.00
Petroleum and products, copra, and similar materials	9	33	9	33	83.00	378.50
Linseed oils	8	2	8	2	80.40	40.00
Gums, resins, and similar materials	1	2	1	2	5.00	20.00
Gastric juice, clinical examinations		2		2		8.00
Foods and alcohols and beverages	239	118	239	118	873.20	97.67
Food preservatives and coloring matters	15		15		89.00	
Medicines and similar articles	10	5	10	5	345.00	121.60
Miscellaneous chemical analyses and examinations	32	16	32	16	204.70	122.00
Assays	650	513	650	507	957.76	1,341.50
Waters, chemical	31	14	31	14	571.50	288.00
Waters, biological	9	12	9	12	270.00	309.00
Fæces	1,118	171	1,118	171	3,352.33	427.00
Sputum	21	50	21	46	63.00	138.00
Blood	20	21	20	21	60.00	73.00
Culture	2	4	2	4	10.00	25.00
Widal test	6	2	6	2	18.00	6.00
Wassermann test	257	239	257	239	2,502.88	2,390.00
Leprosy		1		1		3.00
Urines	1		1		25.00	
Gonococci	10	32	10	32	30.00	96.00
Histological examinations	13	6	13	6	130.00	60.00

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1915	1916	1915	1916	1915	1916
Miscellaneous—Continued.						
Miscellaneous biological work and examinations	5	12	5	12	28.00	91.00
Vaccine virus	1,726	52,193	1,726	52,193	102.00	631.80
Miscellaneous sera and preparations	726,764	470,770	726,764	470,770	2,502.88	2,090.34
Photographic work	2,247	2,125	2,247	2,125	736.09	678.50
Natural history specimens	82	24	82	24	208.48	451.38
Shop work	15	12	15	12	83.82	61.61
Miscellaneous work	17	69	17	69	5,249.94	8,343.44
Supplies		829		829		1,756.96
Sales of publications					4,548.99	3,551.42
Refunded, work not done, etc. (deducted)					(102.50)	(202.61)
Power, gas, etc					31,125.23	16,769.98
Total	733,869	527,971	733,866	527,956	57,239.70	42,548.19
Grand total	7,180,625	4,637,325	7,011,863	4,268,420	98,197.62	81,335.08

TABLE III.—*Comparative statement showing expenditures and income during the fiscal year 1916 (January 1 to December 31, 1916) as compared with the fiscal years 1914 and 1915.*

EXPENDITURES.

Item.	Fiscal year 1914	1915	1916
	Pesos.	*Pesos.*	*Pesos.*
Salaries and wages, etc.:			
Salaries and wages including accrued leave	224, 113. 73	191, 349. 75	231, 180. 22
Traveling expenses of personnel	14, 212. 98	12, 026. 16	12, 964. 40
Total	238, 326. 71	203, 375. 91	244, 144. 62
Apparatus, supplies, etc.:			
Consumption of supplies and materials including subscriptions	74, 407. 70	73, 156. 96	72, 929. 96
Apparatus and equipment including books	25, 450. 77	14, 448. 88	21, 429. 44
Total	99, 858. 47	87, 605. 84	94, 359. 40
Miscellaneous:			
Rental of buildings	720. 00	682. 50	481. 50
Postal, telegraph, telephone, and cable service	4, 932. 12	4, 764. 62	3, 990. 65
Freight, express and delivery service	980. 09	1, 176. 32	1, 725. 92
Printing and binding reports, documents and publications	28, 695. 67	33, 590. 61	21, 238. 19
Illumination and power service	402. 53	1, 647. 02	1, 628. 53
Contingent service	3, 631. 71	3, 079. 95	4, 520. 06
Maintenance and repairs of furniture and equipment	712. 92	4, 409. 75	4, 200. 00
Total	40, 075. 04	49, 350. 77	37, 784. 85
Grand total	378, 260. 22	340, 332. 52	376, 288. 87
INCOME.			
Receipts from operation	115, 486. 73	98, 197. 62	81, 335. 08
Prior year income	(838. 20)	2, 665. 88	647. 89
Sales of supplies	488. 82	. 73	----------
Sales of fixed assets	2, 716. 45	25, 889. 93	1, 575. 70
Total	117, 853. 80	126, 754. 16	83, 558. 67
Appropriation account:			
Appropriated	381, 084. 00	360, 895. 50	371, 976. 00
Allotted by the Emergency Board	----------	10, 000. 00	25, 000. 00
Brought forward for accounts payable	68, 586. 98	58, 891. 87	27, 856. 39
Restored from previous fiscal years	9, 834. 35	----------	20, 039. 31
Total	459, 505. 33	429, 787. 37	444, 871. 70

MISCELLANEOUS ACCOUNTS (1916).

Item.	Available.	Expended.	Balance.
Tiqui-tiqui distribution, Act No. 2376	3, 532. 64	2, 590. 21	942. 43
Improvement of the Aquarium, Act No. 2494	2, 000. 00	1, 918. 27	81. 73
Replacement fund	5, 064. 45	2, 280. 02	2, 784. 43
Total	10, 597. 09	6, 788. 50	3, 808. 59

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